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THE RELATION OF MATURITY OF CALIFORNIA PLUMS TO SHIPPING AND DESSERT QUALITY

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THE RELATION OF MATURITY OF CALIFORNIA PLUMS TO SHIPPING AND DESSERT QUALITY

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INTRODUCTION

Since California plums are produced two to three thousand miles from the principal eastern markets, the harvesting and shipping of them is a most important problem. Eight to twelve days must usually elapse between the time of loading the fruit into refrigerator cars and its arrival on the market. From one to three days additional may be necessary before it reaches the retail purchaser. Under these conditions it is necessary, therefore, that highly perishable fruits, such as plums, be harvested and shipped before becoming tree ripe, if they are to carry satisfactorily. Firmness is not only essential for successful long-distance shipment but after the necessary rehandling the fruit must be delivered to the retailer in a firm, sound condition.

On the other hand, if picked too early, plums will not ripen with good dessert quality. In general, the nearer tree ripe the fruit when picked, the better the dessert quality when fully ripe. The commercial grower and shipper must therefore pick and handle the fruit so it will arrive in a satisfactory market condition, and at the same time secure the highest possible dessert quality. In view of the insistent demand from dealers that nothing but hard fruit be shipped, there has developed a tendency to harvest a portion of the crop at least, so early as to sacrifice considerable of its eating quality. This investigation accordingly was undertaken to determine as accurately as possible under existing transportation conditions when the leading plum varieties should be harvested.

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OUTLINE OF THE INVESTIGATIONS

In commercial practice, the time of picking plums for eastern shipment has been based almost entirely upon the color of the fruit. In attacking this problem it was planned to determine as accurately as possible the physical and chemical changes occurring in plums as they ripen on the tree, and after removal from the tree; and how these changes are associated with color and desert quality.

Changes studied as the fruit of different varieties matured on the tree included (1) increase in size, (2) change in color, (3) change in firmness of flesh, (4) change in soluble solids and sugar content, and (5) change in acidity. Following picking, similar studies were made on fruit while being held under conditions approximating those that prevail in refrigerator cars while in transit to eastern markets. The shipping quality, or the way the fruit holds up following picking at various maturity stages, was also determined for each variety.

Fruit from Placer County, which county ranks first in the state in the quantity of shipping plums produced, was chosen for the major part of the investigations. Some fruit was also obtained from the river section of Sacramento County. With the assistance of a committee of shippers, ten important varieties, including those that had proved most difficult to get to market in satisfactory condition, were selected. These varieties included Beauty, Formosa, Climax, Santa Rosa, Burbank, Wickson, Duarte, Diamond, Giant and President.⁴

During the seasons of 1924 and 1925 fruit of each variety was secured from three or four different orchards. While differences in soil, amount and frequency of irrigations and other cultural factors have some influence on keeping quality, any differences noted were considered of slight consequence in trying to determine picking maturity in general. Hence in 1926 all varieties were secured from a single orchard. This orchard was typical of the Newcastle-Auburn section, all trees being of full bearing age, growing in a sandy loam soil and receiving frequent irrigations during the growing season.

COLLECTON AND HANDLING OF SAMPLES

Fruit of each variety was picked according to color. The first pickings usually corresponded to the stage at which the earliest commercial harvest occurs. A second picking corresponded to recom-

⁴ The three last-named varieties are of the European group (*Prunus domestica*) while the other varieties belong to the Japanese group (*Prunus salicina*) the type of plums now most largely grown in California for fresh shipment.

mended commercial harvest color, while a third picking was made in a more advanced or mature color stage than that commercially recommended. The earliest fruit from the tree to reach a certain color stage, and the latest fruit from the tree to reach that same stage were also taken for comparison as to their holding and other qualities. From $1\frac{1}{2}$ to 2 crates of four baskets each constituted a picking. The specimens were taken from all parts of the tree.

Each sample picked was immediately packed in regular plum baskets according to commercial practice, and shipped by express to the Division of Pomology at Berkeley where the fruit arrived late the same day as harvested.

The following morning, the fruit was tested for firmness and samples taken for analyses. The remainder of each picking was then placed in separate cold storage rooms, held under temperatures comparable to those usually existing in the bottom half and in the top of the load in refrigerator cars, 43° and 52° Fahrenheit, respectively. After 12 days, the usual time required for California fruit to reach the New York market, the fruit was removed, again tested for firmness and samples taken for analyses. The remaining part of each picking held under the above temperatures was then placed under a $65-70^{\circ}$ temperature until it became overripe.

MATURITY CHANGES

CHANGES IN PLUMS AS THEY RIPEN ON THE TREE

Increase in Size.—Increase in size of fruit during the ripening period was determined at approximately six-day intervals from the time the fruit lost its dark-green color until it was full color or ready to drop from the tree. Thirty to forty representative specimens from different parts of the tree were marked and the horizontal circumference or diameters of these measured at the time of each experimental picking. From these measurements the approximate increase in volume was calculated.⁵

In this experiment no effort was made to secure the rate of growth during the early stages of development but only that from the time the earliest pickings were made until the fruit was considered too soft for long distance shipment. These measurements were thought sufficient to indicate how long growth continued and to what extent tonnage might be lost by extremely early picking. The results of some of these measurements have been averaged and summarized in table 1.

⁵ Assuming a spherical shape for the fruit and little change in form during the period of measurement, the volume varies approximately as the cube of the diameter.

TABLE 1
INCREASE IN SIZE OF PLUMS

| Variety | Color stage | Average diameter | Number of fruits | Between stages | Percentage increase | |
|-----------------|------------------------------------------------|------------------|------------------|----------------|---------------------|--------|
| | | | | | Diameter | Volume |
| | | (centimeters) | | | | |
| Beauty..... | (a) Green..... | 4.04 | 21 | | | |
| | (b) Straw tip to light straw..... | 4.14 | 19 | a-b | 2.4 | 7.4 |
| | (c) Light pink to pink tip..... | 4.42 | 31 | b-c | 6.3 | 20.5 |
| | (d) $\frac{1}{4}$ to $\frac{1}{2}$ red..... | 4.67 | 27 | c-d | 5.3 | 17.1 |
| Formosa..... | (a) Straw tip to light straw..... | 4.70 | 19 | | | |
| | (b) Full straw to yellow..... | 4.92 | 56 | a-b | 4.5 | 14.1 |
| | (c) Slight to $\frac{1}{2}$ pink..... | 5.38 | 27 | b-c | 8.5 | 27.8 |
| | (d) $\frac{1}{2}$ to $\frac{3}{4}$ pink..... | 5.40 | 48 | c-d | 3.7 | 11.5 |
| Santa Rosa..... | (a) Green..... | 4.27 | 19 | | | |
| | (b) Straw tip to straw..... | 4.38 | 27 | a-b | 2.5 | 7.7 |
| | (c) Pink tip to $\frac{1}{4}$ pink..... | 4.67 | 24 | b-c | 6.2 | 19.8 |
| | (d) $\frac{3}{4}$ to full red..... | 5.05 | 37 | c-d | 7.5 | 24.2 |
| | (e) Full dark red..... | 5.23 | 30 | d-e | 3.4 | 10.5 |
| Climax..... | (a) Green..... | 4.24 | 9 | | | |
| | (b) Straw tip to light straw..... | 4.40 | 37 | a-b | 3.6 | 11.2 |
| | (c) $\frac{1}{2}$ to full straw..... | 4.63 | 39 | b-c | 4.9 | 15.8 |
| | (d) Pink tip to slight pink..... | 4.87 | 27 | c-d | 4.9 | 15.4 |
| | (e) $\frac{3}{4}$ to full red..... | 4.94 | 16 | d-e | 1.4 | 4.3 |
| Wickson..... | (a) Green..... | 4.04 | 31 | | | |
| | (b) Straw tip..... | 4.62 | 72 | a-b | 12.5 | 42.4 |
| | (c) Light straw..... | 4.92 | 21 | b-c | 6.1 | 19.4 |
| | (d) Full straw to yellow..... | 5.09 | 45 | c-d | 3.3 | 10.2 |
| Burbank..... | (a) Green to light straw..... | 4.20 | 44 | | | |
| | (b) Full straw to trace pink..... | 4.36 | 46 | a-b | 3.7 | 11.5 |
| | (c) Slight pink to $\frac{1}{4}$ red..... | 4.53 | 21 | b-c | 3.7 | 11.8 |
| | (d) Full yellow to $\frac{3}{4}$ red..... | 4.66 | 28 | c-d | 2.8 | 8.6 |
| Duarte..... | (a) Green to straw tip..... | 4.30 | 21 | | | |
| | (b) Pink tip to $\frac{1}{2}$ light pink..... | 4.60 | 32 | a-b | 6.5 | 20.8 |
| | (c) $\frac{1}{2}$ pink to pink..... | 4.71 | 45 | b-c | 2.3 | 7.2 |
| | (d) Full red..... | 4.73 | 32 | c-d | 0.4 | 1.3 |
| Diamond..... | (a) Trace blue to blue tip..... | 4.02 | 27 | | | |
| | (b) $\frac{1}{3}$ to $\frac{3}{4}$ blue..... | 4.27 | 37 | a-b | 3.5 | 10.8 |
| | (c) Full blue..... | 4.31 | 35 | b-c | 2.3 | 7.0 |
| | (d) Full dark blue..... | 4.46 | 35 | c-d | 3.1 | 9.6 |
| Giant..... | (a) Straw to trace pink..... | 4.40 | 32 | | | |
| | (b) Slight to $\frac{1}{2}$ pink..... | 4.52 | 23 | a-b | 2.6 | 7.7 |
| | (c) $\frac{3}{4}$ to full pink..... | 4.68 | 19 | b-c | 3.5 | 10.9 |
| | (d) $\frac{3}{4}$ to full red..... | 4.72 | 29 | c-d | 0.8 | 3.0 |
| | (a) Slight to $\frac{1}{2}$ purple..... | 4.55 | 24 | | | |
| | (b) $\frac{1}{2}$ to $\frac{3}{4}$ purple..... | 4.58 | 25 | a-b | 0.6 | 2.0 |
| | (c) Full purple..... | 4.68 | 27 | b-c | 2.1 | 6.0 |

Naturally the attention given the trees in different orchards, particularly the frequency of irrigations or water content of the soil and the size of the crop on the trees are factors influencing the rate of growth. Under rather unfavorable conditions instances were found where the fruit made practically no increase after the first measurements were made. On the other hand, the greatest gain over a period of ten to fifteen days was 4.5 per cent in volume per day. The average gain of all the varieties studied, from all orchards, was between 1.5 and 2.0 per cent by volume per day.

Increase in size is usually slightly greater in the earlier stages of ripening—from the time the fruit changes from a decided green to slight color—than it is in the later color stages. Apparently, however, growth in plums does not stop before they attain their full color, which is at a later date than the fruit of most varieties is ever picked for eastern shipment.

The varieties listed in the above table are given in their approximate order of ripening and it is significant to note that the later varieties show a smaller daily gain in volume than the earlier sorts. The probable explanation of this is that they have had a longer period in which to make their growth. The significant feature, however, of these differences is that the earlier varieties—those which are most often picked prematurely—are the ones making the most rapid gains when harvested. With these varieties five or six days' delay in harvesting would, in many instances, not only give fruit of a more desirable size but might easily result in a 10 per cent increase in the number of crates produced.

While each day's delay in picking results in larger sized fruit, and a heavier tonnage, the picking date obviously cannot be postponed beyond the time when the fruit has satisfactory carrying quality. In the majority of cases it is doubted if growers, under present methods of refrigeration, would be justified in delaying picking later than is at present customary practice. However, at the beginning of each shipping season there are always some who in an effort to secure high prices for the first fruit on the market, sacrifice enough in size to offset the difference which a few days would make in price. As discussed later, even more is sacrificed in quality.

Change in Color.—Within a period of ten days to several weeks before becoming full ripe, most varieties of plums undergo marked changes in color. These changes, while continuous, are as a matter of practical convenience divided into several more or less distinct stages. In the Japanese varieties the earliest of these changes often spoken of as "breaking," is when the decided green of the skin changes to a

light whitish or yellowish green. With most varieties this yellowish green changes to a more decided yellow or straw color, following which the plum gradually assumes its characteristic yellow or red color. The fruits are thus spoken of commercially as "straw tip," "slight color," "red tip," "three-fourths red," etc. With varieties such as the Duarte there is little or none of the straw or yellow stage, the characteristic red mottled effect developing while the skin is still green. The flesh also early assumes a deep red color. In the blue or purple varieties, the color changes are usually from green to greenish blue or reddish purple followed by dark blue or purple.

As color changes are especially noticeable, they have been and are used as the most important single test for maturity. The color of the fruit has, therefore, been used as the picking standard in this investi-

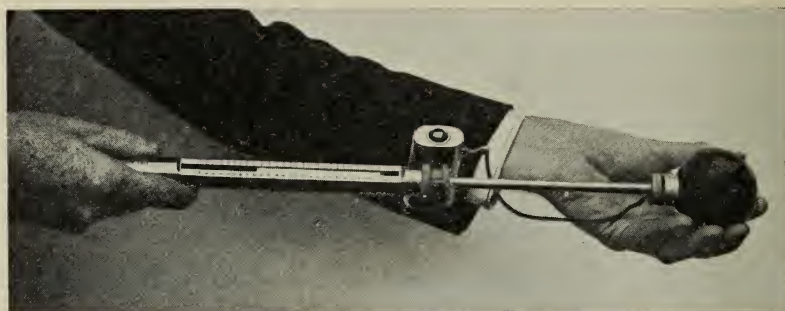


Fig. 1.—Use of pressure tester in determining firmness of plums.

gation, and the firmness, chemical changes, and shipping quality has been determined at certain definite color stages. Detailed data of maturity changes for all varieties studied are given in table 2.

Softening of the Flesh.—With the increase in color of fruit there is normally softening of the flesh. With such fruits as plums, softening is an outstanding characteristic of the ripening process. As soft fruit is unsuitable for long distance shipment, its firmness when picked is intimately associated with carrying quality.

Firmness of the fruit at time of picking was determined by means of the pressure tester illustrated in figure 1, and described in detail in a previous publication.⁶ The pressure in pounds required to force a plunger point $\frac{7}{16}$ inch in diameter into the flesh of the fruit to a depth of $\frac{5}{16}$ of an inch, was measured. Fifteen to twenty plums were used for each determination. Each fruit was tested twice, once on each cheek, the skin having first been removed.

⁶ Magness, J. R., and George F. Taylor. An improved type of pressure tester for the determination of fruit maturity. U. S. D. A. Cir. 350:1-8. 1925.

The average results of these tests on fruit from each district studied are shown in column 4 of table 2. The averages of all the tests taken at the same color stage are also given.

As would be expected there is considerable variation in the firmness of different varieties when in a similar color stage. In all varieties tested, however, as shown by the data in table 2, there is a marked softening of the fruit as color increases and maturity advances. The variety, Beauty, for example, illustrated in the graph, figure 2, showed



Fig. 2.—Showing physical and chemical changes in Beauty and Climax plums as they ripen on the tree.

an average pressure test above 13 pounds in the straw tip stage, while in the red tip stage the average was only slightly over 6 pounds. Burbank tested above 20 pounds in the straw tip to light straw stage, and under 11 pounds when yellow to one-fourth red. Other varieties show similar rapid softening as maturity advances.

In a number of lots, fruit in a similar color stage, from the same trees, was picked several days apart. The earliest plums to reach a certain color stage are usually those on the outside of the tree, where they are well exposed to the light. The latest fruit on the tree to reach any fixed color stage is usually that from the lower branches and shaded portions. When fruit of later pickings but of a similar color stage was compared to earlier picked fruit from the same tree, it was found that the earlier fruit was almost invariably firmer in texture.

As will be discussed later, shipping quality in any variety seems to be rather closely associated with the firmness of the fruit when picked. Consequently, the earliest fruit on the tree to reach a given color will usually have better carrying quality than the later ripening fruit, picked in the same color stage. These results indicate that the first picking of any variety may be allowed to carry more color than the later pickings, and have equally good shipping quality.

Not only do different varieties vary in the firmness of the flesh when in similar maturity stages, but the rate of softening also varies greatly. Late varieties, such as Giant and President, soften much more slowly than such varieties as Beauty or Climax. The average rate of softening while the fruit is coloring on the tree usually ranges from $\frac{1}{2}$ to 1 pound per day.

Increase in Soluble Solids.—Since hydrometer tests for soluble solids have been used for standardizing picking practices for citrus fruits and grapes, and such tests are quickly and easily made, it was thought they might serve as a measure of maturity for plums. Juice was, therefore, extracted from each sample harvested and the soluble solids determined by means of Balling scale hydrometers. The results of these determinations are recorded in column 5, table 2.

Between the time of the earliest pickings and those when the fruit is of practically full color there is an increase of from 15 to 25 per cent in the quantity of soluble solids. This increase was found not to be gradual, but to come in larger part after the fruit is considered to be too mature for eastern shipment. The increase during the earlier ripening stages will be noted to be from almost nothing to 10 or 12 per cent. Incidentally samples from different orchards often show greater differences when in similar color and firmness stages than is noted between two maturity stages. The increase in specific gravity of the juice, therefore, is not sufficiently closely correlated with maturity and carrying quality in plums to be of value as an index for picking maturity.

TABLE 2
PHYSICAL AND CHEMICAL CHANGES IN PLUMS AT DIFFERENT STAGES OF MATURITY

| Source of fruit (1) | Date when picked (2) | Color stage when picked (3) | Firmness (lbs. pressure) (4) | Soluble solids in juice (% Balling) | | % Total | | % Reducing | | Acid in juice (% Malic) | | Acid in fruit (% Malic) | | Dessert quality (fruit full ripe) (15) |
|------------------------|-------------------------|--------------------------------|---------------------------------|-------------------------------------|------------------|--------------------|------------------|--------------------|-------------------|-------------------------|-------------------|-------------------------|-------------------|-------------------------------------------|
| | | | | When picked (5) | When ripe (6) | When picked (7) | When ripe (8) | When picked (9) | When ripe (10) | When picked (11) | When ripe (12) | When picked (13) | When ripe (14) | |
| BEAUTY | | | | | | | | | | | | | | |
| Loomis..... | 6/ 3/25 | Green to straw tip..... | 11.0 | 9.4 | 9.3 | ..... | ..... | 4.40 | 4.52 | 1.86 | 0.51 | 2.48 | 2.54 | Fair to good |
| Courtland..... | 6/ 4/25 | Green to straw tip..... | 10.0 | 10.3 | 9.5 | ..... | 5.20 | 4.49 | 4.47 | 1.47 | 1.21 | 2.18 | 1.94 | Good |
| Auburn..... | 6/ 8/25 | Green to straw tip..... | 15.4 | 11.9 | 11.0 | ..... | 5.53 | 5.58 | 4.66 | 2.23 | 0.54 | 2.96 | 2.87 | Fair to good |
| Newcastle..... | 5/26/26 | Green to straw tip..... | 16.6 | 10.7 | 9.8 | 3.80 | 3.90 | 3.54 | 3.40 | 2.06 | 1.19 | 2.52 | 1.89 | Poor to fair |
| | | Average..... | 13.2 | 10.6 | 9.9 | | 4.88 | 4.50 | 4.26 | 1.90 | 0.86 | 2.53 | 2.31 | |
| Courtland..... | 6/ 4/25 | Straw to slight pink tip..... | 5.8 | 10.2 | 10.2 | ..... | 5.73 | 4.74 | 4.68 | 1.22 | 1.01 | 2.22 | 1.82 | Good |
| Courtland..... | 6/ 9/25 | Straw to slight pink tip..... | 5.4 | 10.4 | 10.6 | ..... | 5.99 | 5.05 | 4.90 | 1.05 | 0.48 | 2.15 | 1.98 | Fair to good |
| Auburn..... | 6/ 8/25 | Straw to slight pink tip..... | 10.9 | 11.6 | 11.7 | ..... | 5.97 | 5.82 | 5.09 | 1.77 | 0.83 | 2.97 | 2.82 | Fair to good |
| Auburn..... | 6/13/25 | Straw to slight pink tip..... | 11.7 | 13.0 | 12.1 | ..... | 6.43 | 6.26 | 5.56 | 1.70 | 0.99 | 3.08 | 2.05 | Good |
| Newcastle..... | 6/ 2/24 | Straw to slight pink tip..... | 11.1 | 11.3 | 11.1 | 4.34 | 4.94 | 3.80 | 4.70 | 1.43 | 0.43 | ..... | 1.87 | Fair |
| | | Average..... | 9.0 | 11.3 | 11.1 | | 5.81 | 5.13 | 4.99 | 1.43 | 0.75 | 2.60 | 2.11 | |
| Loomis..... | 6/ 3/25 | Straw to red tip..... | 7.3 | 10.4 | 10.3 | ..... | ..... | 4.47 | 4.69 | 1.47 | 1.21 | 1.47 | 1.21 | Fair to good |
| Loomis..... | 6/ 8/25 | Straw to red tip..... | 7.0 | 11.2 | 11.0 | ..... | ..... | 4.59 | 4.71 | 1.33 | 0.57 | 2.58 | 2.26 | Fair to good |
| Loomis..... | 6/11/25 | Straw to red tip..... | 4.5 | 11.5 | 11.6 | ..... | ..... | 5.30 | 6.27 | 1.19 | 0.68 | 2.42 | 2.35 | Fair |
| Courtland..... | 6/12/25 | Straw to red tip..... | 5.7 | 11.5 | 12.1 | ..... | 7.09 | 6.01 | 6.13 | 1.10 | 0.70 | 2.03 | 1.91 | Good |
| | | Average..... | 6.1 | 11.1 | 11.2 | | | 5.17 | 5.45 | 1.27 | 0.79 | 2.38 | 2.24 | |
| Loomis..... | 6/ 8/25 | ½ to ¾ red..... | 5.1 | 12.0 | 11.4 | ..... | ..... | 4.23 | 5.83 | 1.09 | 0.53 | 2.56 | 2.43 | Fair to good |
| Loomis..... | 6/11/25 | ½ to ¾ red..... | 3.3 | 12.0 | 11.7 | ..... | ..... | 5.62 | 6.49 | 0.92 | 1.03 | 2.46 | 2.32 | Good |
| Courtland..... | 6/ 9/25 | ½ to ¾ red..... | 4.0 | 10.7 | 10.9 | ..... | 6.28 | 5.16 | 5.19 | 0.97 | 0.57 | 2.34 | 1.96 | Good |
| Courtland..... | 6/12/25 | ½ to ¾ red..... | 4.3 | 13.4 | 13.0 | ..... | 7.83 | 6.34 | 6.85 | 0.94 | 0.74 | 2.29 | 1.98 | Very good |
| Auburn..... | 6/13/25 | ½ to ¾ red..... | 6.4 | 12.7 | 12.0 | ..... | 6.65 | 5.94 | 6.44 | 1.54 | 1.04 | 2.38 | 2.56 | Good |
| Newcastle..... | 6/ 8/26 | ½ to ¾ red..... | 6.1 | 12.7 | 12.3 | 6.70 | 6.40 | 5.84 | 5.94 | 0.76 | 0.55 | 1.83 | 1.90 | Fair |
| Newcastle..... | 6/18/26 | ½ to ¾ red..... | 4.8 | 12.8 | 12.8 | 6.50 | 6.96 | 5.60 | 5.96 | 0.66 | 0.49 | 1.79 | 1.77 | Fair |
| | | Average..... | 4.9 | 12.3 | 12.0 | 6.60 | 6.82 | 5.53 | 6.10 | 0.98 | 0.71 | 2.31 | 2.12 | |

TABLE 2—(Continued)
PHYSICAL AND CHEMICAL CHANGES IN PLUMS AT DIFFERENT STAGES OF MATURITY

| Source of fruit (1) | Date when picked (2) | Color stage when picked (3) | Firmness (lbs. pressure) (4) | Soluble solids in juice (% Balling) | | Sugar in fruit | | | Acid in juice (% Malic) | | | Acid in fruit (% Malic) | | Dessert quality (fruit full ripe) (15) |
|------------------------|-------------------------|------------------------------------|---------------------------------|-------------------------------------|------------------|--------------------|------------------|--------------------|-------------------------|---------------------|-------------------|-------------------------|-------------------|-------------------------------------------|
| | | | | | | | | | | | | | | |
| | | | | When picked (5) | When ripe (6) | When picked (7) | When ripe (8) | When picked (9) | When ripe (10) | When picked (11) | When ripe (12) | When picked (13) | When ripe (14) | |
| CLIMAX | | | | | | | | | | | | | | |
| Loomis..... | 6/ 8/25 | Green to faint straw tip..... | 21.9 | 10.0 | 9.5 | ..... | 4.35 | 4.22 | 3.69 | 1.96 | 1.00 | 2.30 | 2.07 | Poor |
| Auburn..... | 6/16/25 | Green to faint straw tip..... | 27.2 | 10.2 | 9.8 | ..... | 5.19 | 4.76 | 4.23 | 2.37 | 0.84 | 2.31 | 1.89 | Poor |
| Courtland..... | 6/12/25 | Green to faint straw tip..... | 26.1 | 11.9 | 10.2 | 6.90 | 5.99 | 5.75 | 5.09 | 1.22 | 0.56 | 1.70 | 1.12 | Very poor |
| Average..... | | | 25.1 | 10.7 | 9.8 | | 5.18 | 4.91 | 4.33 | 1.85 | 0.80 | 2.10 | 1.69 | |
| Loomis..... | 6/13/25 | Full straw to greenish-yellow..... | 20.7 | 10.1 | 10.3 | ..... | 5.47 | 4.58 | 4.71 | 1.84 | 1.00 | 2.12 | 2.01 | Poor to fair |
| Auburn..... | 6/16/25 | Full straw to greenish-yellow..... | 26.4 | 11.0 | 10.2 | ..... | 5.35 | 5.06 | 4.38 | 2.46 | 0.76 | 2.48 | 1.99 | Poor |
| Courtland..... | 6/18/25 | Full straw to greenish-yellow..... | 19.3 | 12.7 | 11.9 | 7.13 | 7.64 | 5.62 | 5.66 | 1.19 | 0.46 | 1.59 | 1.30 | Fair |
| Newcastle..... | 6/10/26 | Full straw to greenish-yellow..... | 16.6 | 10.7 | 10.5 | 5.50 | 4.74 | 4.80 | 3.60 | 1.48 | 0.80 | 1.91 | 1.66 | Fair to good |
| Average..... | | | 20.7 | 11.1 | 10.7 | 6.31 | 5.80 | 5.01 | 4.59 | 1.74 | 0.75 | 2.02 | 1.74 | |
| Loomis..... | 6/13/25 | Greenish-yellow to red tip..... | 17.4 | 11.5 | 10.7 | ..... | 5.59 | 4.84 | 4.52 | 1.75 | 0.95 | 2.42 | 2.12 | Good |
| Loomis..... | 6/16/25 | Greenish-yellow to red tip..... | 15.5 | 10.8 | 11.5 | ..... | 5.96 | 4.79 | 4.41 | 1.90 | 0.30 | 2.25 | 2.04 | Fair |
| Loomis..... | 6/19/25 | Greenish-yellow to red tip..... | 13.6 | 11.8 | 12.9 | 5.91 | 7.34 | 5.07 | 5.10 | 1.69 | 0.63 | ..... | 2.15 | Fair |
| Average..... | | | 15.5 | 11.4 | 11.7 | | 6.30 | 4.90 | 4.68 | 1.78 | 0.63 | 2.33 | 2.10 | |
| Loomis..... | 6/23/25 | ¼ to ¾ red..... | 11.6 | 12.7 | 12.0 | 6.86 | 7.33 | 5.05 | 5.33 | 1.46 | 0.31 | 2.03 | 1.80 | Good |
| Loomis..... | 6/23/25 | ¼ to ¾ red..... | 8.8 | 13.7 | 14.3 | 7.58 | 8.55 | 5.32 | 5.06 | 1.21 | 0.30 | 2.21 | 1.86 | Good |
| Auburn..... | 7/ 7/25 | ¼ to ¾ red..... | 6.9 | 16.6 | 15.1 | 9.52 | 9.32 | 5.64 | 5.43 | 1.00 | 0.12 | 2.17 | 1.81 | Variable; poor to good |
| Newcastle..... | 6/22/26 | ¼ to ¾ red..... | 8.6 | 14.8 | 15.9 | ..... | 8.80 | ..... | ..... | 0.98 | 0.29 | 1.61 | 1.71 | Very good |
| Average..... | | | 8.9 | 14.4 | 14.3 | 7.99 | 8.50 | 5.34 | 5.44 | 1.16 | 0.25 | 2.00 | 1.79 | |

TABLE 2—(Continued)
PHYSICAL AND CHEMICAL CHANGES IN PLUMS AT DIFFERENT STAGES OF MATURITY

| Source of fruit (1) | Date when picked (2) | Color stage when picked (3) | Firmness (lbs. pressure) (4) | Soluble solids in juice (% Balling) | | Sugar in fruit | | | | Acid in juice (% Malic) | | Acid in fruit (% Malic) | | Dessert quality (fruit full ripe) (15) | |
|------------------------|-------------------------|--------------------------------|------------------------------------|----------------------------------------|-------------|--------------------|------------------|------------------|---------------------|----------------------------|-------------------|----------------------------|-------------------|----------------------------------------------|--------------------|
| | | | | When picked (5) | When (6) | When picked (7) | When ripe (8) | When ripe (9) | When picked (10) | When picked (11) | When ripe (12) | When picked (13) | When ripe (14) | | |
| | | | | | | | | | | | | | | | % Total | % Reducing |
| FORMOSA | | | | | | | | | | | | | | | |
| Newcastle..... | 6/ 3/26 | Green to slight straw..... | 10.8 | 8.1 | 7.4 | 4.30 | ..... | ..... | 3.54 | ..... | 0.94 | 0.57 | ..... | 0.99 | Poor to fair |
| Newcastle..... | 6/ 3/26 | Straw to pink tip..... | 11.0 | 10.3 | 7.5 | 5.70 | ..... | ..... | 4.50 | ..... | ..... | ..... | ..... | 0.92 | Poor to fair |
| Newcastle..... | 6/ 8/26 | Straw to yellow..... | 8.0 | 10.4 | 7.5 | 6.40 | ..... | ..... | 4.20 | ..... | 0.75 | 0.43 | 1.22 | 1.01 | Poor to fair |
| Newcastle..... | 6/16/26 | Yellow to 1/4 pink..... | 4.6 | 11.3 | 11.0 | 5.20 | 6.46 | 4.00 | 3.18 | 0.56 | 0.26 | 1.06 | 1.06 | 1.06 | Good |
| Newcastle..... | 6/18/26 | 1/2 to 3/4 color..... | 5.1 | 11.8 | 12.3 | 6.74 | 5.46 | 4.30 | 3.48 | 0.50 | 0.25 | 1.14 | 0.90 | 0.90 | Good |
| PRESIDENT | | | | | | | | | | | | | | | |
| Newcastle..... | 7/23/26 | 1/4 blue..... | 13.7 | ..... | ..... | 8.66 | 8.40 | 5.22 | 5.40 | ..... | ..... | ..... | 1.30 | 1.20 | Good to very good* |
| Newcastle..... | 7/27/26 | 1/2 blue..... | 12.2 | ..... | ..... | 8.17 | 8.46 | 5.00 | 5.84 | ..... | ..... | ..... | 1.08 | 0.93 | Very good |
| Newcastle..... | 7/29/26 | 3/4 blue..... | 10.5 | ..... | ..... | 8.46 | 9.00 | 4.80 | 6.06 | ..... | ..... | ..... | 1.19 | 1.05 | Very good |
| Newcastle..... | 8/ 3/26 | Full blue..... | 10.0 | ..... | ..... | 9.00 | 10.20 | 5.74 | 6.70 | ..... | ..... | ..... | 1.03 | 0.99 | Very good |

* Fruits wilted slightly.

TABLE 2—(Continued)
PHYSICAL AND CHEMICAL CHANGES IN PLUMS AT DIFFERENT STAGES OF MATURITY

| Source of fruit (1) | Date when picked (2) | Color stage when picked (3) | Firmness (lbs. pressure) (4) | Soluble solids in juice (% Balling) | | Sugar in fruit | | | | Acid in juice (% Malic) | | | Acid in fruit (% Malic) | | Dessert quality (fruit full ripe) (15) | |
|------------------------|-------------------------|-------------------------------------------|---------------------------------|-------------------------------------|------------------|----------------|------------|--------------------|------------------|-------------------------|-------------------|---------------------|-------------------------|---------------------|-------------------------------------------|-------------------|
| | | | | When picked (5) | When ripe (6) | % Total | % Reducing | When picked (7) | When ripe (8) | When picked (9) | When ripe (10) | When picked (11) | When ripe (12) | When picked (13) | | When ripe (14) |
| | | | | | | | | | | | | | | | | |
| SANTA ROSA | | | | | | | | | | | | | | | | |
| Newcastle..... | 6/11/25 | Greenish-yellow to pink tip..... | 17.1 | 11.7 | 12.3 | 6.24 | 6.21 | 5.15 | 4.70 | 2.19 | 0.70 | 2.85 | 2.36 | Poor to fair | | |
| Courtland..... | 6/12/25 | Greenish-yellow to pink tip..... | 21.1 | 11.6 | 12.1 | 6.00 | 6.66 | 5.06 | 5.08 | 1.88 | 0.71 | 2.48 | 1.98 | Poor | | |
| Loomis..... | 6/13/25 | Greenish-yellow to pink tip..... | 21.6 | 11.1 | 11.0 | ..... | 5.81 | 4.50 | 4.35 | 2.34 | 1.03 | 2.74 | 2.12 | Fair | | |
| Newcastle..... | 6/11/26 | Greenish-yellow to pink tip..... | 16.3 | 13.6 | 13.2 | 6.70 | 6.30 | 5.52 | 4.34 | 1.48 | 0.87 | 1.83 | 1.74 | Good | | |
| | | Average..... | 19.0 | 12.0 | 12.1 | 6.31 | 6.24 | 5.06 | 4.62 | 1.97 | 0.83 | 1.97 | 2.05 | | | |
| Newcastle..... | 6/11/25 | $\frac{1}{4}$ to $\frac{3}{4}$ color..... | 15.4 | 13.1 | 13.1 | 6.56 | 6.61 | 5.27 | 4.82 | 2.07 | 0.53 | 2.77 | 2.37 | Fair to good | | |
| Newcastle..... | 6/16/25 | $\frac{3}{4}$ to $\frac{1}{2}$ color..... | 15.8 | 12.4 | 12.9 | ..... | 6.47 | 5.23 | 4.44 | 2.01 | 0.49 | 2.74 | 2.39 | Good | | |
| Courtland..... | 6/18/25 | $\frac{1}{4}$ to $\frac{3}{4}$ color..... | 16.6 | 12.7 | 13.0 | 7.91 | 6.80 | 6.06 | 4.76 | 1.88 | 0.64 | 2.44 | 2.15 | Fair to good | | |
| Courtland..... | 6/18/25 | $\frac{1}{4}$ to $\frac{3}{4}$ color..... | 14.4 | 13.7 | 13.5 | 7.83 | 7.54 | 5.61 | 5.09 | 1.63 | 0.55 | 2.38 | 2.15 | Good | | |
| Loomis..... | 6/19/25 | $\frac{3}{4}$ to $\frac{1}{2}$ color..... | 14.3 | 12.6 | 12.3 | 6.44 | 6.07 | 4.53 | 3.96 | 1.84 | 0.53 | 2.44 | 2.12 | Good | | |
| Newcastle..... | 6/23/26 | $\frac{1}{4}$ to $\frac{3}{4}$ color..... | 15.8 | 14.4 | 13.4 | 6.96 | 6.70 | 5.30 | 4.40 | 1.41 | 0.80 | 1.95 | 1.75 | Very good | | |
| | | Average..... | 15.4 | 13.1 | 13.0 | 7.14 | 6.69 | 5.33 | 4.58 | 1.80 | 0.59 | 2.45 | 2.15 | | | |
| Newcastle..... | 6/16/25 | $\frac{3}{4}$ to full light red..... | 13.1 | 12.9 | 14.2 | ..... | 7.44 | 4.96 | 4.58 | 1.88 | 0.30 | 2.59 | 2.38 | Very good | | |
| Newcastle..... | 6/19/25 | $\frac{3}{4}$ to full light red..... | 12.1 | 14.2 | 14.4 | 7.80 | 8.02 | 5.15 | 4.95 | 1.78 | 0.47 | 2.46 | 2.34 | Very good | | |
| Courtland..... | 6/20/25 | $\frac{3}{4}$ to full light red..... | 8.1 | 15.2 | 15.1 | 9.09 | 9.24 | 5.53 | 5.09 | 1.06 | 0.26 | 1.88 | 1.67 | Very good | | |
| Loomis..... | 6/30/25 | $\frac{3}{4}$ to full light red..... | 4.1 | 14.2 | 14.6 | 8.70 | 8.65 | 4.92 | 5.43 | 0.86 | 0.26 | 1.60 | 1.45 | Very good | | |
| Newcastle..... | 6/17/26 | $\frac{3}{4}$ to full light red..... | 8.3 | 14.5 | 15.4 | 7.70 | 7.86 | 5.34 | 4.44 | 0.87 | 0.15 | 1.50 | 1.48 | Very good | | |
| | | Average..... | 9.1 | 14.2 | 14.7 | 8.32 | 8.24 | 5.16 | 4.89 | 1.20 | 0.32 | 1.98 | 1.80 | | | |

TABLE 2—(Continued)
PHYSICAL AND CHEMICAL CHANGES IN PLUMS AT DIFFERENT STAGES OF MATURITY

| Source of fruit (1) | Date when picked (2) | Color stage when picked (3) | Firmness (lbs. pressure) (4) | Soluble solids in juice (% Balling) | | Sugar in fruit | | | Acid in juice (% Malic) | | Acid in fruit (% Malic) | | Desert quality (fruit full ripe) (15) |
|------------------------|-------------------------|--------------------------------|---------------------------------|-------------------------------------|---------------|-----------------|---------------|------------|-------------------------|----------------|-------------------------|----------------|------------------------------------------|
| | | | | When picked (5) | When ripe (6) | % Total | | % Reducing | When picked (11) | When ripe (12) | When picked (13) | When ripe (14) | |
| | | | | | | When picked (7) | When ripe (8) | | | | | | |
| BURBANK | | | | | | | | | | | | | |
| Courtland..... | 6/18/25 | Straw tip to light straw..... | 22.0 | 13.1 | 12.0 | 7.68 | 8.25 | 3.58 | 1.61 | 0.95 | 1.93 | 1.80 | Good |
| Penryn..... | 6/19/25 | Straw tip to light straw..... | 22.5 | 12.1 | 13.4 | 6.59 | 6.93 | 2.84 | 1.80 | 1.28 | 2.84 | 2.58 | Fair |
| Newcastle..... | 6/16/26 | Straw tip to light straw..... | 17.6 | 12.9 | 11.9 | 6.30 | 8.00 | 2.50 | 1.15 | 0.60 | 1.48 | 1.43 | Fair |
| | | Average..... | 20.7 | 12.7 | 12.4 | 6.86 | 7.73 | 2.97 | 1.52 | 0.94 | 2.08 | 1.94 | |
| Courtland..... | 6/25/25 | Full straw to yellow..... | 15.5 | 14.5 | 13.5 | 9.12 | 9.05 | 3.87 | 1.55 | 1.02 | 1.79 | 1.62 | Poor* |
| Courtland..... | 6/25/25 | Full straw to yellow..... | 15.5 | 14.2 | 14.5 | 9.17 | 9.19 | 3.81 | 1.36 | 0.95 | 1.73 | 1.58 | Poor* |
| Penryn..... | 6/19/25 | Full straw to yellow..... | 18.9 | 12.9 | 13.5 | 6.89 | 7.55 | 2.75 | 1.77 | 0.98 | 2.13 | 1.92 | Good |
| Newcastle..... | 7/ 2/25 | Full straw to yellow..... | 10.6 | 12.8 | 13.6 | 7.68 | 8.01 | 3.34 | 1.13 | 0.71 | 1.93 | 1.79 | Good |
| Newcastle..... | 6/23/26 | Full straw to yellow..... | 16.3 | 12.8 | ..... | 7.10 | 7.86 | 2.34 | 0.97 | ..... | 1.54 | 1.50 | Fair to good |
| | | Average..... | 15.4 | 13.4 | 13.8 | 7.99 | 8.33 | 3.22 | 1.36 | 0.92 | 1.82 | 1.68 | |
| Courtland..... | 7/ 6/25 | Yellow to ¾ red..... | 11.2 | 16.3 | 15.0 | 10.37 | 10.43 | 3.49 | 1.04 | 0.86 | 1.46 | 1.33 | Good |
| Courtland..... | 7/ 6/25 | Yellow to ¾ red..... | 9.7 | 16.2 | 17.4 | 11.06 | 11.01 | 3.70 | 0.92 | 0.82 | 1.41 | 1.40 | Fair† |
| Penryn..... | 7/ 7/25 | Yellow to ¾ red..... | 12.9 | 16.1 | 16.5 | 9.64 | 10.37 | 3.33 | 1.08 | 0.61 | 1.52 | 1.35 | Fair to good |
| Penryn..... | 7/17/25 | Yellow to ¾ red..... | 10.5 | 16.0 | 17.5 | 10.73 | 11.27 | 3.81 | 0.91 | 0.54 | 1.16 | 1.09 | Good† |
| Newcastle..... | 7/ 9/25 | Yellow to ¾ red..... | 10.1 | 14.0 | 18.3 | 9.27 | 9.73 | 3.07 | 1.04 | 1.00 | 1.64 | 1.50 | Good† |
| Newcastle..... | 7/17/25 | Yellow to ¾ red..... | 8.9 | 15.0 | 15.7 | 9.58 | 10.90 | 3.01 | 1.11 | 0.80 | 1.69 | 1.28 | Good† |
| Newcastle..... | 6/29/26 | Yellow to ¾ red..... | 12.5 | 15.0 | ..... | 8.50 | 9.44 | 2.54 | 0.78 | ..... | 1.01 | 1.11 | Fair to good |
| Newcastle..... | 7/ 6/26 | Yellow to ¾ red..... | 11.1 | 15.5 | ..... | 8.90 | 9.30 | 2.54 | 0.69 | ..... | 1.12 | 1.02 | Fair to good |
| | | Average..... | 10.9 | 15.5 | 16.7 | 9.76 | 10.31 | 3.19 | 0.95 | 0.77 | 1.38 | 1.26 | |

* Fruit very dry and mealy.

† A little over-ripe in 12 days at 52° F.

TABLE 2—(Continued)
PHYSICAL AND CHEMICAL CHANGES IN PLUMS AT DIFFERENT STAGES OF MATURITY

| Source of fruit (1) | Date when picked (2) | Color stage when picked (3) | Firmness (lbs. pressure) (4) | Soluble solids in juice (% Balling) | | Sugar in fruit | | | | Acid in juice (% Malic) | | Acid in fruit (% Malic) | | Dessert quality (fruit full ripe) (15) | |
|------------------------|-------------------------|--------------------------------|---------------------------------|-------------------------------------|---------------|-----------------|---------------|-----------------|----------------|-------------------------|----------------|-------------------------|----------------|-------------------------------------------|--|
| | | | | When picked (5) | When ripe (6) | % Total | | % Reducing | | When picked (11) | When ripe (12) | When picked (13) | When ripe (14) | | |
| | | | | | | When picked (7) | When ripe (8) | When picked (9) | When ripe (10) | | | | | | |
| WICKSON | | | | | | | | | | | | | | | |
| Auburn..... | 7/ 7/24 | Green to straw tip..... | | 11.9 | 12.1 | 4.70 | 5.00 | | | | | | | Poor; failed to ripen properly Fair | |
| Auburn..... | 7/ 2/25 | Green to straw tip..... | 20.2 | 12.3 | 13.5 | 7.25 | 7.53 | 5.53 | 5.62 | 1.05 | 0.63 | 1.57 | 1.72 | | |
| Auburn..... | 6/18/26 | Green to straw tip..... | 22.2 | 10.5 | 11.2 | 5.20 | 5.60 | 3.90 | 4.04 | 1.16 | 0.32 | 1.26 | 1.35 | | |
| Auburn..... | | Average..... | 21.2 | 11.6 | 12.3 | 5.72 | 6.04 | 4.71 | 4.83 | 1.10 | 0.47 | 1.41 | 1.53 | Fair | |
| Auburn..... | 7/ 9/25 | Straw tip to straw..... | 14.6 | 13.2 | 14.7 | 8.12 | 8.16 | 5.02 | 4.32 | 0.94 | 0.88 | 1.69 | 1.38 | | |
| Penryn..... | 7/ 3/25 | Straw tip to straw..... | 12.6 | 12.2 | 12.8 | 7.36 | 7.62 | 4.89 | 5.07 | 0.79 | 0.69 | 1.41 | 1.38 | | |
| Courland..... | 7/ 7/25 | Straw tip to straw..... | 10.6 | 12.9 | 14.1 | 8.09 | 7.89 | 4.50 | 4.63 | 0.66 | 0.37 | 1.24 | 1.28 | Good | |
| Newcastle..... | 6/25/26 | Straw tip to straw..... | 16.3 | 12.2 | ..... | 6.54 | 6.06 | 4.40 | 4.12 | 0.84 | ..... | 1.23 | 1.38 | | |
| Newcastle..... | 7/ 1/26 | Straw tip to straw..... | 13.9 | 12.9 | 12.8 | 6.70 | 6.62 | 3.84 | 4.34 | 0.70 | 0.52 | 1.16 | 1.02 | | |
| Auburn..... | | Average..... | 13.6 | 12.7 | 13.6 | 7.36 | 7.27 | 4.53 | 4.50 | 0.79 | 0.61 | 1.35 | 1.29 | Fair | |
| Penryn..... | 7/13/25 | Light yellow..... | 8.1 | 13.1 | 14.1 | 7.98 | 8.49 | 4.48 | 4.23 | 0.70 | 0.49 | 1.41 | 1.24 | | |
| Penryn..... | 7/17/25 | Light yellow..... | 8.3 | 14.0 | 14.0 | 9.37 | 9.27 | 4.64 | 4.48 | 0.60 | 0.27 | 1.19 | 1.13 | | |
| Courland..... | 7/14/25 | Light yellow..... | 6.4 | 14.9 | 14.2 | 10.10 | 9.80 | 4.44 | 4.53 | 0.62 | 0.26 | 1.37 | 1.17 | Very good | |
| Auburn..... | 7/23/25 | Light yellow..... | 7.5 | 15.5 | 15.9 | 9.50 | 9.21 | 5.88 | 5.20 | 0.56 | 0.44 | 1.25 | 1.10 | | |
| Newcastle..... | 7/ 7/25 | Light yellow..... | 10.5 | 15.1 | ..... | 7.80 | 7.46 | 4.86 | 4.80 | 0.65 | ..... | 1.14 | 1.07 | | |
| Auburn..... | | Average..... | 8.2 | 14.5 | 14.5 | 8.95 | 8.85 | 4.86 | 4.65 | 0.62 | 0.36 | 1.27 | 1.14 | Fair to good | |
| Penryn..... | 7/13/25 | Light yellow..... | 8.1 | 13.1 | 14.1 | 7.98 | 8.49 | 4.48 | 4.23 | 0.70 | 0.49 | 1.41 | 1.24 | | |
| Penryn..... | 7/17/25 | Light yellow..... | 8.3 | 14.0 | 14.0 | 9.37 | 9.27 | 4.64 | 4.48 | 0.60 | 0.27 | 1.19 | 1.13 | | |
| Courland..... | 7/14/25 | Light yellow..... | 6.4 | 14.9 | 14.2 | 10.10 | 9.80 | 4.44 | 4.53 | 0.62 | 0.26 | 1.37 | 1.17 | Very good | |
| Auburn..... | 7/23/25 | Light yellow..... | 7.5 | 15.5 | 15.9 | 9.50 | 9.21 | 5.88 | 5.20 | 0.56 | 0.44 | 1.25 | 1.10 | | |
| Newcastle..... | 7/ 7/25 | Light yellow..... | 10.5 | 15.1 | ..... | 7.80 | 7.46 | 4.86 | 4.80 | 0.65 | ..... | 1.14 | 1.07 | | |
| Auburn..... | | Average..... | 8.2 | 14.5 | 14.5 | 8.95 | 8.85 | 4.86 | 4.65 | 0.62 | 0.36 | 1.27 | 1.14 | Fair to good | |
| Penryn..... | 7/13/25 | Light yellow..... | 8.1 | 13.1 | 14.1 | 7.98 | 8.49 | 4.48 | 4.23 | 0.70 | 0.49 | 1.41 | 1.24 | | |
| Penryn..... | 7/17/25 | Light yellow..... | 8.3 | 14.0 | 14.0 | 9.37 | 9.27 | 4.64 | 4.48 | 0.60 | 0.27 | 1.19 | 1.13 | | |
| Courland..... | 7/14/25 | Light yellow..... | 6.4 | 14.9 | 14.2 | 10.10 | 9.80 | 4.44 | 4.53 | 0.62 | 0.26 | 1.37 | 1.17 | Very good | |
| Auburn..... | 7/23/25 | Light yellow..... | 7.5 | 15.5 | 15.9 | 9.50 | 9.21 | 5.88 | 5.20 | 0.56 | 0.44 | 1.25 | 1.10 | | |
| Newcastle..... | 7/ 7/25 | Light yellow..... | 10.5 | 15.1 | ..... | 7.80 | 7.46 | 4.86 | 4.80 | 0.65 | ..... | 1.14 | 1.07 | | |
| Auburn..... | | Average..... | 8.2 | 14.5 | 14.5 | 8.95 | 8.85 | 4.86 | 4.65 | 0.62 | 0.36 | 1.27 | 1.14 | Fair to good | |
| Penryn..... | 7/13/25 | Light yellow..... | 8.1 | 13.1 | 14.1 | 7.98 | 8.49 | 4.48 | 4.23 | 0.70 | 0.49 | 1.41 | 1.24 | | |
| Penryn..... | 7/17/25 | Light yellow..... | 8.3 | 14.0 | 14.0 | 9.37 | 9.27 | 4.64 | 4.48 | 0.60 | 0.27 | 1.19 | 1.13 | | |
| Courland..... | 7/14/25 | Light yellow..... | 6.4 | 14.9 | 14.2 | 10.10 | 9.80 | 4.44 | 4.53 | 0.62 | 0.26 | 1.37 | 1.17 | Very good | |
| Auburn..... | 7/23/25 | Light yellow..... | 7.5 | 15.5 | 15.9 | 9.50 | 9.21 | 5.88 | 5.20 | 0.56 | 0.44 | 1.25 | 1.10 | | |
| Newcastle..... | 7/ 7/25 | Light yellow..... | 10.5 | 15.1 | ..... | 7.80 | 7.46 | 4.86 | 4.80 | 0.65 | ..... | 1.14 | 1.07 | | |
| Auburn..... | | Average..... | 8.2 | 14.5 | 14.5 | 8.95 | 8.85 | 4.86 | 4.65 | 0.62 | 0.36 | 1.27 | 1.14 | Fair to good | |
| Penryn..... | 7/13/25 | Light yellow..... | 8.1 | 13.1 | 14.1 | 7.98 | 8.49 | 4.48 | 4.23 | 0.70 | 0.49 | 1.41 | 1.24 | | |
| Penryn..... | 7/17/25 | Light yellow..... | 8.3 | 14.0 | 14.0 | 9.37 | 9.27 | 4.64 | 4.48 | 0.60 | 0.27 | 1.19 | 1.13 | | |
| Courland..... | 7/14/25 | Light yellow..... | 6.4 | 14.9 | 14.2 | 10.10 | 9.80 | 4.44 | 4.53 | 0.62 | 0.26 | 1.37 | 1.17 | Very good | |
| Auburn..... | 7/23/25 | Light yellow..... | 7.5 | 15.5 | 15.9 | 9.50 | 9.21 | 5.88 | 5.20 | 0.56 | 0.44 | 1.25 | 1.10 | | |
| Newcastle..... | 7/ 7/25 | Light yellow..... | 10.5 | 15.1 | ..... | 7.80 | 7.46 | 4.86 | 4.80 | 0.65 | ..... | 1.14 | 1.07 | | |
| Auburn..... | | Average..... | 8.2 | 14.5 | 14.5 | 8.95 | 8.85 | 4.86 | 4.65 | 0.62 | 0.36 | 1.27 | 1.14 | Fair to good | |
| Penryn..... | 7/13/25 | Light yellow..... | 8.1 | 13.1 | 14.1 | 7.98 | 8.49 | 4.48 | 4.23 | 0.70 | 0.49 | 1.41 | 1.24 | | |
| Penryn..... | 7/17/25 | Light yellow..... | 8.3 | 14.0 | 14.0 | 9.37 | 9.27 | 4.64 | 4.48 | 0.60 | 0.27 | 1.19 | 1.13 | | |
| Courland..... | 7/14/25 | Light yellow..... | 6.4 | 14.9 | 14.2 | 10.10 | 9.80 | 4.44 | 4.53 | 0.62 | 0.26 | 1.37 | 1.17 | Very good | |
| Auburn..... | 7/23/25 | Light yellow..... | 7.5 | 15.5 | 15.9 | 9.50 | 9.21 | 5.88 | 5.20 | 0.56 | 0.44 | 1.25 | 1.10 | | |
| Newcastle..... | 7/ 7/25 | Light yellow..... | 10.5 | 15.1 | ..... | 7.80 | 7.46 | 4.86 | 4.80 | 0.65 | ..... | 1.14 | 1.07 | | |
| Auburn..... | | Average..... | 8.2 | 14.5 | 14.5 | 8.95 | 8.85 | 4.86 | 4.65 | 0.62 | 0.36 | 1.27 | 1.14 | Fair to good | |
| Penryn..... | 7/13/25 | Light yellow..... | 8.1 | 13.1 | 14.1 | 7.98 | 8.49 | 4.48 | 4.23 | 0.70 | 0.49 | 1.41 | 1.24 | | |
| Penryn..... | 7/17/25 | Light yellow..... | 8.3 | 14.0 | 14.0 | 9.37 | 9.27 | 4.64 | 4.48 | 0.60 | 0.27 | 1.19 | 1.13 | | |
| Courland..... | 7/14/25 | Light yellow..... | 6.4 | 14.9 | 14.2 | 10.10 | 9.80 | 4.44 | 4.53 | 0.62 | 0.26 | 1.37 | 1.17 | Very good | |
| Auburn..... | 7/23/25 | Light yellow..... | 7.5 | 15.5 | 15.9 | 9.50 | 9.21 | 5.88 | 5.20 | 0.56 | 0.44 | 1.25 | 1.10 | | |
| Newcastle..... | 7/ 7/25 | Light yellow..... | 10.5 | 15.1 | ..... | 7.80 | 7.46 | 4.86 | 4.80 | 0.65 | ..... | 1.14 | 1.07 | | |
| Auburn..... | | Average..... | 8.2 | 14.5 | 14.5 | 8.95 | 8.85 | 4.86 | 4.65 | 0.62 | 0.36 | 1.27 | 1.14 | Fair to good | |
| Penryn..... | 7/13/25 | Light yellow..... | 8.1 | 13.1 | 14.1 | 7.98 | 8.49 | 4.48 | 4.23 | 0.70 | 0.49 | 1.41 | 1.24 | | |
| Penryn..... | 7/17/25 | Light yellow..... | 8.3 | 14.0 | 14.0 | 9.37 | 9.27 | 4.64 | 4.48 | 0.60 | 0.27 | 1.19 | 1.13 | | |
| Courland..... | 7/14/25 | Light yellow..... | 6.4 | 14.9 | 14.2 | 10.10 | 9.80 | 4.44 | 4.53 | 0.62 | 0.26 | 1.37 | 1.17 | Very good | |
| Auburn..... | 7/23/25 | Light yellow..... | 7.5 | 15.5 | 15.9 | 9.50 | 9.21 | 5.88 | 5.20 | 0.56 | 0.44 | 1.25 | 1.10 | | |
| Newcastle..... | 7/ 7/25 | Light yellow..... | 10.5 | 15.1 | ..... | 7.80 | 7.46 | 4.86 | 4.80 | 0.65 | ..... | 1.14 | 1.07 | | |
| Auburn..... | | Average..... | 8.2 | 14.5 | 14.5 | 8.95 | 8.85 | 4.86 | 4.65 | 0.62 | 0.36 | 1.27 | 1.14 | Fair to good | |
| Penryn..... | 7/13/25 | Light yellow..... | 8.1 | 13.1 | 14.1 | 7.98 | 8.49 | 4.48 | 4.23 | 0.70 | 0.49 | 1.41 | 1.24 | | |
| Penryn..... | 7/17/25 | Light yellow..... | 8.3 | 14.0 | 14.0 | 9.37 | 9.27 | 4.64 | 4.48 | 0.60 | 0.27 | 1.19 | 1.13 | | |
| Courland..... | 7/14/25 | Light yellow..... | 6.4 | 14.9 | 14.2 | 10.10 | 9.80 | 4.44 | 4.53 | 0.62 | 0.26 | 1.37 | 1.17 | Very good | |
| Auburn..... | 7/23/25 | Light yellow..... | 7.5 | 15.5 | 15.9 | 9.50 | 9.21 | 5.88 | 5.20 | 0.56 | 0.44 | 1.25 | 1.10 | | |
| Newcastle..... | 7/ 7/25 | Light yellow..... | 10.5 | 15.1 | ..... | 7.80 | 7.46 | 4.86 | 4.80 | 0.65 | ..... | 1.14 | 1.07 | | |
| Auburn..... | | Average..... | 8.2 | 14.5 | 14.5 | 8.95 | 8.85 | 4.86 | 4.65 | 0.62 | 0.36 | 1.27 | 1.14 | Fair to good | |
| Penryn..... | 7/13/25 | Light yellow..... | 8.1 | 13.1 | 14.1 | 7.98 | 8.49 | 4.48 | 4.23 | 0.70 | 0.49 | 1.41 | 1.24 | | |
| Penryn..... | 7/17/25 | Light yellow..... | 8.3 | 14.0 | 14.0 | 9.37 | 9.27 | 4.64 | 4.48 | 0.60 | 0.27 | 1.19 | 1.13 | | |
| Courland..... | 7/14/25 | Light yellow..... | 6.4 | 14.9 | 14.2 | 10.10 | 9.80 | 4.44 | 4.53 | 0.62 | 0.26 | 1.37 | 1.17 | Very good | |
| Auburn..... | 7/23/25 | Light yellow..... | 7.5 | 15.5 | 15.9 | 9.50 | 9.21 | 5.88 | 5.20 | 0.56 | 0.44 | 1.25 | 1.10 | | |
| Newcastle..... | 7/ 7/25 | Light yellow..... | 10.5 | 15.1 | ..... | 7.80 | 7.46 | 4.86 | 4.80 | 0.65 | ..... | 1.14 | 1.07 | | |
| Auburn..... | | Average..... | 8.2 | 14.5 | 14.5 | 8.95 | 8.85 | 4.86 | 4.65 | 0.62 | 0.36 | 1.27 | 1.14 | Fair to good | |
| Penryn..... | 7/13/25 | Light yellow..... | 8.1 | 13.1 | 14.1 | 7.98 | 8.49 | 4.48 | 4.23 | 0.70 | 0.49 | 1.41 | 1.24 | | |
| Penryn..... | 7/17/25 | Light yellow..... | 8.3 | 14.0 | 14.0 | 9.37 | 9.27 | 4.64 | 4.48 | 0.60 | 0.27 | 1.19 | 1.13 | | |
| Courland..... | 7/14/25 | Light yellow..... | 6.4 | 14.9 | 14.2 | 10.10 | 9.80 | 4.44 | 4.53 | 0.62 | 0.26 | 1.37 | 1.17 | Very good | |
| Auburn..... | 7/23/25 | Light yellow..... | 7.5 | 15.5 | 15.9 | 9.50 | 9.21 | 5.88 | 5.20 | 0.56 | 0.44 | 1.25 | 1.10 | | |
| Newcastle..... | 7/ 7/25 | Light yellow..... | 10.5 | 15.1 | ..... | 7.80 | 7.46 | 4.86 | 4.80 | 0.65 | ..... | 1.14 | 1.07 | | |
| Auburn..... | | Average..... | 8.2 | 14.5 | 14.5 | 8.95 | 8.85 | 4.86 | 4.65 | 0.62 | 0.36 | 1.27 | 1.14 | Fair to good | |
| Penryn..... | 7/13/25 | Light yellow..... | 8.1 | 13.1 | 14.1 | 7.98 | 8.49 | 4.48 | 4.23 | 0.70 | 0.49 | 1.41 | 1.24 | | |
| Penryn..... | 7/17/25 | Light yellow..... | 8.3 | 14.0 | 14.0 | 9.37 | 9.27 | 4.64 | 4.48 | 0.60 | 0.27 | 1.19 | 1.13 | | |
| Courland..... | 7/14/25 | Light yellow..... | 6.4 | 14.9 | 14.2 | 10.10 | 9.80 | 4.44 | 4.53 | 0.62 | 0.26 | 1.37 | 1.17 | Very good | |
| Auburn..... | 7/23/25 | Light yellow..... | 7.5 | 15.5 | 15.9 | 9.50 | 9.21 | 5.88 | 5.20 | 0.56 | 0.44 | 1.25 | 1.10 | | |
| Newcastle..... | 7/ 7/25 | Light yellow..... | 10.5 | 15.1 | ..... | 7.80 | 7.46 | 4.86 | 4.80 | 0.65 | ..... | 1.14 | 1.07 | | |
| Auburn..... | | Average..... | 8.2 | 14.5 | 14.5 | 8.95 | 8.85 | 4.86 | 4.65 | 0.62 | 0.36 | 1.27 | 1.14 | Fair to good | |
| Penryn..... | 7/13/25 | Light yellow..... | 8.1 | 13.1 | 14.1 | 7.98 | 8.49 | 4.48 | 4.23 | 0.70 | 0.49 | 1.41 | 1.24 | | |
| Penryn..... | 7/17/25 | Light yellow..... | 8.3 | 14.0 | 14.0 | 9.37 | 9.27 | 4.64 | 4.48 | 0.60 | 0.27 | 1.19 | 1.13 | | |
| Courland..... | 7/14/25 | Light yellow..... | 6.4 | 14.9 | 14.2 | 10.10 | 9.80 | 4.44 | 4.53 | 0.62 | 0.26 | 1.37 | 1.17 | Very good | |
| Auburn..... | 7/23/25 | Light yellow..... | 7.5 | 15.5 | 15.9 | 9.50 | 9.21 | 5.88 | 5.20 | 0.56 | 0.44 | 1.25 | 1.10 | | |
| Newcastle..... | 7/ 7/25 | Light yellow..... | 10.5 | 15.1 | ..... | 7.80 | 7.46 | 4.86 | 4.80 | 0.65 | ..... | 1.14 | 1.07 | | |
| Auburn..... | | Average..... | 8.2 | 14.5 | 14.5 | 8.95 | 8.85 | 4.86 | 4.65 | 0.62 | 0.36 | 1.27 | 1.14 | Fair to good | |
| Penryn..... | 7/13/25 | Light yellow..... | 8.1 | 13.1 | 14.1 | 7.98 | 8.49 | 4.48 | 4.23 | 0.70 | 0.49 | 1.41 | 1.24 | | |
| Penryn..... | 7/17/25 | Light yellow..... | 8.3 | 14.0 | 14.0 | 9.37 | 9.27 | 4.64 | 4.48 | 0.60 | 0.27 | 1.19 | 1.13 | | |
| Courland..... | 7/14/25 | Light yellow..... | 6.4 | 14.9 | 14.2 | 10.10 | 9.80 | 4.44 | 4.53 | 0.62 | 0.26 | 1.37 | 1.17 | Very good | |
| Auburn | | | | | | | | | | | | | | | |

TABLE 2—(Continued)
PHYSICAL AND CHEMICAL CHANGES IN PLUMS AT DIFFERENT STAGES OF MATURITY

| Source of fruit (1) | Date when picked (2) | Color stage when picked (3) | Firm- ness (lbs. pres- sure) (4) | Soluble solids in juice (% Balling) | | | Sugar in fruit | | | Acid in juice (% Malic) | | | Acid in fruit (% Malic) | | Dessert quality (fruit full ripe) (15) |
|----------------------------------------------------------------|------------------------------------------|-----------------------------------|-------------------------------------------------|-------------------------------------------|---------------------|-----------------------|---------------------|-----------------------|----------------------|----------------------------|----------------------|------------------------|----------------------------|------------------------|--------------------------------------------------|
| | | | | | | | % Total | | % Reducing | | | | | | |
| | | | | When picked (5) | When ripe (6) | When picked (7) | When ripe (8) | When picked (9) | When ripe (10) | When picked (11) | When ripe (12) | When picked (13) | When ripe (14) | | |
| | | | | DUARTE | | | | | | | | | | | |
| Penryn..... Newcastle..... | 7/ 3/25 6/23/26 | Green to slight red..... | 11.5 | 12.4 | 11.8 | 6.53 | 6.50 | 4.26 | 4.74 | 1.62 | 0.46 | 1.45 | 1.48 | Fair to good | |
| | | Green to slight red..... | 18.6 | 11.7 | 11.9 | 5.40 | 5.60 | 3.90 | 4.26 | 1.65 | 0.42 | 1.75 | 1.79 | Poor | |
| | | Average..... | 15.0 | 12.0 | 11.8 | 5.96 | 6.05 | 4.08 | 4.50 | 1.63 | 0.44 | 1.60 | 1.63 | | |
| | | | | | | | | | | | | | | | |
| Penryn..... Auburn..... Newcastle..... Newcastle..... | 7/ 3/25 7/ 9/25 7/ 1/26 7/ 8/26 | ½ to ¾ light red..... | 9.8 | 13.4 | 13.2 | 7.36 | 8.49 | 3.94 | 4.76 | 0.80 | 0.41 | 1.31 | 1.31 | Good | |
| | | ½ to ¾ light red..... | 10.2 | 14.6 | 13.7 | 8.10 | 8.09 | 4.12 | 5.07 | 0.99 | 0.69 | 1.48 | 1.43 | Good | |
| | | ½ to ¾ light red..... | 16.0 | 12.8 | 14.1 | 6.06 | 5.60 | 4.26 | 3.80 | 1.09 | 0.21 | 1.50 | 1.58 | Fair to good | |
| | | ½ to ¾ light red..... | 12.2 | 14.7 | 15.3 | 6.20 | 7.74 | 3.96 | 4.70 | 0.93 | 0.37 | 1.56 | 1.64 | Good | |
| | | Average..... | 12.0 | 13.8 | 14.0 | 6.93 | 7.48 | 4.07 | 4.58 | 0.95 | 0.42 | 1.46 | 1.49 | | |
| Auburn..... Auburn..... Penryn..... Newcastle..... | 7/25/24 7/25/24 7/13/25 7/14/26 | Full light red to medium dark red | ..... | 14.9 | 15.5 | 6.60 | 6.70 | ..... | ..... | ..... | ..... | ..... | ..... | Good | |
| | | Full light red to medium dark red | ..... | 16.2 | 16.5 | 6.60 | 6.50 | ..... | ..... | ..... | ..... | ..... | ..... | Excellent | |
| | | Full light red to medium dark red | 8.7 | 14.9 | 14.9 | 8.49 | 7.43 | 3.94 | 4.82 | 0.85 | 0.48 | 1.43 | 1.42 | Very good to excellent | |
| | | Full light red to medium dark red | 12.2 | 14.6 | 16.6 | 7.14 | 8.50 | 4.12 | 5.32 | 0.78 | 0.21 | 1.32 | 1.23 | Very good | |
| | | Average..... | 10.4 | 15.1 | 15.8 | 7.20 | 7.28 | 4.03 | 5.07 | 0.81 | 0.35 | 1.37 | 1.32 | | |

TABLE 2—(Continued)
PHYSICAL AND CHEMICAL CHANGES IN PLUMS AT DIFFERENT STAGES OF MATURITY

| Source of fruit (1) | Date when picked (2) | Color stage when picked (3) | Firm- ness (lbs. pres- sure) (4) | Soluble solids in juice (% Balling) | | Sugar in fruit | | Acid in juice (% Malic) | | Acid in fruit (% Malic) | | Dessert quality (fruit full ripe) (15) | | |
|------------------------|-------------------------|--------------------------------|-------------------------------------------------|-------------------------------------------|---------------------|----------------|------------|----------------------------|----------------------|----------------------------|----------------------|----------------------------------------------|------|-------------------|
| | | | | When picked (5) | When ripe (6) | % Total | % Reducing | When picked (11) | When ripe (12) | When picked (13) | When ripe (14) | | | |
| | | | | | | | | | | | | | | |
| DIAMOND | | | | | | | | | | | | | | |
| Newcastle..... | 7/ 3/25 | Green, slight purple..... | 15.5 | 11.6 | 10.8 | 5.52 | 5.77 | 4.40 | 4.71 | 2.41 | 2.22 | 2.45 | 2.45 | Fair |
| Penryn..... | 7/ 3/25 | Green, slight purple..... | 15.2 | 12.0 | 12.2 | 6.29 | 6.35 | 4.59 | 4.69 | 2.40 | 2.15 | 2.35 | 2.34 | Poor to fair |
| Courtland..... | 7/ 7/25 | Green, slight purple..... | 16.4 | 10.8 | 10.2 | 5.62 | 5.53 | 4.32 | 4.28 | 2.60 | 2.14 | 2.60 | 2.34 | Fair |
| Newcastle..... | 6/30/26 | Green, slight purple..... | 19.0 | 11.8 | ..... | 5.48 | 4.74 | 3.90 | 3.98 | 2.68 | ..... | 2.40 | 2.46 | Poor |
| | | Average..... | 16.5 | 11.5 | 11.0 | 5.72 | 5.59 | 4.30 | 4.41 | 2.52 | 2.17 | 2.45 | 2.39 | |
| Newcastle..... | 7/ 9/25 | ½ to ⅔ purple..... | 9.2 | 12.2 | 14.3 | 6.48 | 6.68 | 3.99 | 4.41 | 2.24 | 2.22 | 2.34 | 2.34 | Fair to good |
| Penryn..... | 7/ 3/25 | ¾ to ⅔ purple..... | 12.5 | 12.8 | 12.6 | 7.00 | 6.64 | 4.43 | 4.57 | 2.26 | 2.15 | 2.25 | 2.33 | Fair |
| Courtland..... | 7/ 7/25 | ½ to ⅔ purple..... | 13.0 | 12.7 | 11.4 | 7.09 | 6.79 | 4.35 | 4.55 | 2.51 | 2.31 | 2.50 | 2.44 | Fair to good |
| Newcastle..... | 7/ 7/26 | ¾ to ⅔ purple..... | 14.7 | 12.6 | ..... | 5.74 | 5.40 | 3.90 | 4.52 | 2.61 | ..... | 2.52 | 2.57 | Poor |
| Newcastle..... | 7/12/26 | ½ to ⅔ purple..... | 13.2 | 13.1 | ..... | 6.06 | 6.30 | 4.44 | 3.84 | 2.50 | ..... | 2.65 | 2.47 | Good |
| | | Average..... | 12.5 | 12.6 | 12.7 | 6.47 | 6.36 | 4.22 | 4.37 | 2.42 | 2.23 | 2.45 | 2.43 | |
| Newcastle..... | 7/17/25 | ¾ to full purple..... | 7.7 | 12.6 | 14.4 | 8.08 | 7.79 | 4.87 | 4.67 | 2.01 | 1.79 | 2.12 | 2.11 | Good |
| Penryn..... | 7/ 9/25 | ¾ to full purple..... | 10.5 | 12.7 | 14.7 | 7.11 | 7.68 | 4.48 | 5.06 | 2.39 | 2.19 | 2.47 | 2.25 | Good to very good |
| Penryn..... | 7/17/25 | ¾ to full purple..... | 8.0 | 15.1 | 14.9 | 8.04 | 8.52 | 4.99 | 5.31 | 1.80 | 1.02 | 2.24 | 2.19 | Good to very good |
| Courtland..... | 7/16/25 | ¾ to full purple..... | 9.4 | 12.3 | 14.1 | 7.34 | 8.36 | 4.09 | 4.41 | 2.31 | 1.96 | 2.45 | 2.19 | Good |
| Newcastle..... | 7/16/26 | ¾ to full purple..... | 10.4 | 14.0 | ..... | 6.30 | 6.54 | 5.08 | 4.64 | 2.48 | ..... | 2.47 | 2.50 | Good |
| | | Average..... | 9.2 | 13.3 | 14.5 | 7.37 | 7.77 | 4.70 | 4.81 | 2.20 | 1.74 | 2.35 | 2.24 | |

TABLE 2—(Concluded)
PHYSICAL AND CHEMICAL CHANGES IN PLUMS AT DIFFERENT STAGES OF MATURITY

| Source of fruit (1) | Date when picked (2) | Color stage when picked (3) | Firm- ness (lbs. pres- sure) (4) | Soluble solids (% Balling) | | Sugar in fruit | | | | Acid in juice (% Malic) | | Acid in fruit (% Malic) | | Dessert quality (fruit full ripe) (15) |
|-------------------------------------------------------------------------------|-----------------------------------------------------|------------------------------------|-------------------------------------------------|-------------------------------|---------------------|-----------------------|---------------------|---------|------------|----------------------------|----------------------|----------------------------|----------------------|--------------------------------------------------|
| | | | | When picked (5) | When ripe (6) | When picked (7) | When ripe (8) | % Total | % Reducing | When picked (11) | When ripe (12) | When picked (13) | When ripe (14) | |
| | | | | | | | | | | | | | | |
| GIANT | | | | | | | | | | | | | | |
| Loomis..... Auburn..... Newcastle..... | 7/17/25 8/ 4/25 7/ 6/26 | Slight pink..... | 14.6 | 12.5 | 13.9 | 6.73 | 7.34 | 3.84 | 3.74 | 1.00 | ..... | 1.06 | 1.06 | Poor |
| | | Slight pink..... | 20.4 | 11.3 | 13.6 | 6.13 | 6.82 | 4.48 | 4.05 | 1.25 | 0.81 | 1.45 | 1.15 | Poor |
| | | Slight pink..... | 21.1 | 13.5 | ..... | 6.00 | 7.00 | 3.72 | 3.60 | 1.28 | ..... | 1.11 | 0.98 | Poor |
| | | Average..... | 18.7 | 12.4 | 13.7 | 6.29 | 7.05 | 4.01 | 3.80 | 1.18 | ..... | 1.20 | 1.06 | |
| Loomis..... Auburn..... Newcastle..... | 7/23/25 7/30/25 7/13/26 | ½ pink..... | 12.9 | 13.5 | 15.1 | 7.33 | 7.98 | 3.81 | 3.87 | 0.90 | ..... | 1.16 | 1.10 | Fair |
| | | ½ pink..... | 16.2 | 11.9 | 11.3 | 7.00 | 7.07 | 4.31 | 4.05 | 1.00 | 0.55 | 1.08 | 1.02 | Fair to good |
| | | ½ pink..... | 19.7 | 14.7 | ..... | 5.74 | 7.00 | 3.46 | 3.72 | 1.11 | ..... | 1.13 | 1.01 | Good |
| | | Average..... | 16.3 | 13.4 | 13.2 | 6.69 | 7.35 | 3.86 | 3.88 | 1.50 | ..... | 1.12 | 1.04 | |
| Loomis..... Loomis..... Auburn..... Newcastle..... Newcastle..... | 8/ 6/25 8/12/25 8/ 6/25 7/23/26 7/28/26 | ¾ to full red..... | 7.3 | 13.5 | 16.4 | 8.27 | 8.55 | 3.84 | 4.44 | 0.72 | ..... | 0.90 | 0.87 | Fair |
| | | ¾ to full red..... | 6.6 | 15.3 | 17.5 | 8.79 | 9.60 | 3.83 | 3.71 | 0.60 | ..... | 0.88 | 0.80 | Very good |
| | | ¾ to full red..... | 10.4 | 11.8 | 13.1 | 7.30 | 8.05 | 4.10 | 4.73 | 0.79 | 0.66 | 1.13 | 1.04 | Fair |
| | | ¾ to full red..... | 16.5 | 15.1 | ..... | 7.46 | 7.46 | 3.98 | 4.04 | 0.82 | ..... | 0.91 | 0.81 | Very good |
| Newcastle..... Newcastle..... | 7/23/26 7/28/26 | ¾ to full red..... | 12.6 | 16.2 | ..... | 7.80 | 7.46 | 4.28 | 3.90 | 0.70 | ..... | 0.99 | 0.80 | Very good |
| | | Average..... | 10.7 | 14.4 | 15.7 | 7.93 | 8.22 | 4.00 | 4.16 | 0.73 | ..... | 0.96 | 0.86 | |

Increase in Sugar Content.—Dessert quality in fruits is generally closely associated with the sugar and acid content. In addition to the hydrometer tests, popularly known as “sugar tests” but which only roughly parallel actual sugar content, analyses were made of the actual sugar content of the fruit when picked at various color stages. Methods for sugar determinations were as follows:

Small sectors of fruit from 15 to 20 plums, totaling 50 grams in weight were boiled 5 minutes with 125 c.c. of 95 per cent alcohol and 1 gr. CaCO_3 . After grinding in a mortar, sample was made up to 500 c.c. with 50 per cent alcohol, and extracted with daily shaking for seven days. The alcohol was then driven from a sample of the supernatant liquid which was then cleared with neutral lead acetate, centrifuged, and delead with sodium oxalate. Reducing sugars in this solution were determined by the Schaffer—Hartmann method.⁷

Inversion of the non-reducing sugars was accomplished by treating with 10 per cent citric acid in a boiling water bath for 12 minutes, and total sugars determined after inversion.

The data on total sugar content of the fruit at time of picking are shown in column 7, table 2. It is apparent that in every variety there was a marked increase in the sugar content as the fruit ripened on the tree. This continued at approximately a uniform rate during the period over which tests were made. The increase in total sugar usually averaged from 10 to 15 per cent for each color stage or picking condition here recorded. These data are in accord with the fact that in general the sugar content of fruits increases rapidly as they mature on the tree.

There was not a close relationship between the hydrometer test of the juice and the actual sugar content of the fruit. With most varieties the ratio of soluble solids to sugars is approximately that of 2 to 1. From the data presented and also other data, considered too fragmentary to include in table 2, it would seem that this ratio varies slightly as the fruit ripens, the earlier pickings tending toward a wider or higher ratio between soluble solids and sugars while in the better colored fruit the sugars are usually slightly more than half of the hydrometer readings.

The analyses for reducing sugars are given in column 9 of table 2. These sugars are relatively stable in quantity throughout the ripening period, although usually increasing slightly. The differences between the reducing and total sugars (column 7) represent the sucrose or cane sugar present. This shows a rather marked increase between the

⁷ Shaffer, P. A., and A. F. Hartmann. The iodometric determination of copper and its use in sugar analysis. Jour Biol. Chem. 45:349-390. 1921.

different color stages, usually being approximately twice as high in the late pickings as in the early picked fruit. Thus the increase in sugar as the fruit ripens is primarily in sucrose, a form sweet to the taste.

The proportion of sucrose to the total quantity of sugar present varies in the different varieties, Beauty, Climax and Santa Rosa containing only from one-sixth to one-fourth of their total sugar as sucrose, while in most of the other varieties tested the quantity increases from one-third to approximately one-half the total.

Decrease in Acid Content.—Portions of the same fruits used for sugar analysis were also used for acid determinations. Acidity in the juice was determined by titrating 10 cc. of juice with N/10 NaOH, Methyl red proving to be the most satisfactory indicator. Acidity was calculated as malic acid.

In addition to the acidity of the pressed juice, acid in extracted samples of the pulp, representing proportional quantities of skin, and flesh from all portions of the fruit, was determined. The samples were boiled in distilled water, and make up to volume, and preserved with about 0.5 per cent toluene. After not less than three days standing extraction, with daily shaking, the acidity of the supernatant liquid was determined as above.

In contrast to 6 to 10 per cent of sugar in plums when ripe, they contain only 0.5 per cent to 3 per cent of acid. The ratio of acid to sugar is variable, both between varieties and within the same variety. While a difference of 1 or 2 per cent of sugar results in greater sweetness, small increases in the amount of acid influence the flavor even more markedly. The sweetest varieties of plums such as Gaviota and Kelsey contain when ripe less than 1 per cent of acid, whereas the Diamond, noted for its acidity, contains 2 per cent or more.

The quantities of acid in the juice and also in the fruit as a whole are given in table 2, columns 11 and 13, respectively. In practically all cases, there was a distinct decrease in the acidity of the pressed-out juice as the fruit ripened on the tree. This decrease in some cases was as much as 50 per cent of the acid present. The greatest proportionate decrease occurred in Wickson, Beauty, and Duarte, while the least decrease occurred in Diamond.

A slight decrease in acidity also generally occurred when the fruit as a whole was analyzed, although the decrease was much less than in the extracted juice. In the fruit as a whole, Santa Rosa, Wickson, Beauty, Formosa and Climax showed only slight decrease in acidity with advancing maturity. A very large part of the acidity of these varieties, particularly in the more mature fruit, seems to be localized

near the skin, and in the flesh near the pit. Juice coming from the main portion of the flesh contains relatively much less acid. Consequently, fruit of these varieties tastes sweet and pleasant when the juice and central flesh is eaten, but very sour if the skin and the flesh from near the pit is eaten. In the early picked lots, there was relatively little difference in the acidity of the pressed-out juice and of the fruit as a whole. As the fruit of the Japanese plums matured on the tree, less of the total acid was present in the juice, and more in the skin and deep lying flesh. This more rapid loss of acid in the juice continues after harvesting.

CHANGES IN THE FRUIT FOLLOWING PICKING

Removal from the tree marks the cessation of growth and may be said to limit the sugar content of the fruit. Changes in color, firmness and acid continue.

Change in Color.—Plums, unless picked previous to the lightening of the green color, not only change to a straw or yellow after being harvested but also have the ability in the absence of light to develop their characteristic red or blue overcolor. The rate of this development depends largely, if not entirely, upon the temperature to which the fruit is exposed. Under general atmospheric temperatures at harvest time, perhaps only a week will be necessary to become of full color. Under the temperature usually existing in the top of refrigerator cars the fruit is well colored at the time of its arrival on the eastern markets while that loaded in the bottom of the car has changed color but little. Fruit picked before its ground color begins to change and carried under low temperatures usually will not color or ripen satisfactorily.

Firmness.—Softening of the flesh continues following picking. Most varieties of plums, testing between 12 and 20 pounds when picked soften to 1 or 2 pounds when in best eating condition. Again this change varies greatly with differences in temperature, as will be discussed under rates of ripening at different temperatures.

Sugar Content.—At the time of harvesting for commercial shipment, plums not only are firm and possess little color, but have little sweetness or flavor. An important question, therefore, arises as to the increase in sugar content after picking. Comparison of column 8 with column 7 of table 2 will show that on the average there is practically no change in the total quantity of sugar in plums between the time of harvesting and the full ripe stage. In the Burbank and

President varieties, there was a slight increase in sugars during this period, but in all other varieties there was not a significant change in sugar content following picking. There also was no significant variation in the form of the sugar as the fruit ripened following picking, the relative proportions of sucrose and reducing sugars remaining approximately the same.

Thus the sugar content of the fully ripened plums is determined practically entirely by the sugar content when picked. The sweet taste of the fully ripe fruit as compared to the same fruit when picked can not, therefore, be explained by an increase in its sugar content.

Acidity.—From the data in columns 11, 12, 13 and 14 of table 2, giving analyses for acid in the pressed-out juice and in the fruit as a whole when picked and when fully ripe, it must be concluded that the apparent greater sweetness in ripe plums is in reality due to the relatively large decrease in the percentage of acid in the juice. With most of the Japanese varieties the acid in the pressed juice of ripe fruit was only from one-fourth to one-half as much as in similar fruit when picked. Total acidity in the fruit as a whole (columns 13 and 14) did not show a marked reduction between the time of picking and when fully ripe. There was very little significant variation in this regard.

It is apparent that as the Japanese plums ripen following picking, the acid disappears from the juice, and apparently concentrates in the skin region and near the pit. When eating Japanese plums it is noticeable that although the juice has a pleasing, sweet taste, the flesh, particularly near the skin and pit is very sour and astringent.

The Diamond variety, belonging to the species *Prunus domestica* or European plums, showed relatively little decrease in acidity, either in the juice or in the fruit as a whole, during the interval between harvest and the full ripe condition.

RELATION OF MATURITY TO DESSERT QUALITY

Maturity of plums at the time they are picked has a most important relation to their dessert quality. The sugar content is higher, the acidity is lower, and associated with these, the texture and aroma are better in plums which are tree ripe when picked. As shown in table 2, column 15, where the dessert quality of fruit picked in various stages of maturity is recorded, the early pickings were generally poor to fair in quality, while the later pickings were good to very good or excellent. Within the range of picking maturity possible in fruit intended for eastern shipment, the more nearly mature the fruit when picked, the

higher the dessert quality will be. There is relatively little change in the sugar content of plums following picking, and the quality of the ripened product is largely determined by the maturity at picking time.

Early varieties such as Beauty and Climax are sometimes harvested exceedingly green, when showing only slight breaking in their green color. Such fruit not only has a very low sugar content and a correspondingly high acid content, but may fail to color and soften properly. The flesh, rather than becoming tender and possessed of a pleasing flavor, becomes tough and is either acrid or insipid. Wrinkling of the skin and general wilting of the fruit are also of frequent occurrence. Such fruit is not only unattractive but in many cases is entirely inedible.

DETERMINATION OF SHIPPING QUALITY

The shipping quality, or the way plums hold up under actual shipping and commercial conditions, when picked in various stages of maturity was determined in two ways. As mentioned above, lots of all varieties studied, picked in different maturity stages, were shipped to the laboratory and held under temperature conditions which closely approximated the average condition in the top fruit layers, and also in the lower fruit layers, of a standard refrigerator car while in transit from California to the Atlantic seaboard.

In addition to this laboratory study, one of the writers also cooperated with the California Fruit Exchange during 1924, when cars loaded with plums including special test crates were accompanied in transit on a test trip. Car temperatures were taken, and the condition of the fruit when loaded and when unloaded from various portions of the car was carefully noted.

During 1925, selected crates of all varieties studied, picked in different stages of maturity, were loaded into the top and bottom layers of commercial cars, these crates being equipped with recording thermometers, packed in with the fruit. These crates were carefully inspected in New York, and the condition of the fruit upon arrival recorded. This fruit was also held at prevailing New York temperatures following unloading, to determine its holding quality under market conditions.

Finally, during the season of 1926, the various commercial lots of fruit loaded into twenty-five cars destined for New York City were inspected, and the packages numbered in such a way that the position which any package had occupied in the car could be determined after

the car was unloaded. A careful record was made of the condition of arrival of these commercial lots, whose condition at loading was known.

From all of these studies, it has been possible to determine fairly accurately the carrying or shipping quality of the different varieties when harvested at various maturity stages.

HOLDING TESTS, AT CAR TEMPERATURES

Under present transit conditions, approximately 12 days is required to transport fruit from California to the Atlantic seaboard. During this time, fruit in a car is held at varying temperatures, depending upon its position in the car, and also upon the time that has elapsed since loading. Results of a number of tests, details of which will be discussed later, show, however, that the average temperature in the top fruit layer of a carload of plums loaded warm and shipped under standard refrigeration for a period of 12 days is usually about 53° F. In the bottom layer, the average temperature under these same conditions will average about 40° F. In the layers half way up in the car, the average temperature will be around 45 to 47° F. The rate of ripening of plums picked at various stages of maturity, and held for a 12-day period at 52° to 53° F, representing top of load temperatures, and at 43° F, representing the lower half of the load temperatures has been determined.

The condition when picked, and the color, firmness and market condition after 12 days at these temperatures, are recorded in table 3. Pressure tests at the end of six days are also included.

Changes in Color.—From the data in table 3 it is apparent that, at temperatures similar to those prevailing in the top of cars, even the early picked fruit of the different varieties was practically full characteristic color at the end of 12 days. Slightly straw tipped Beauty became full red as did also light to full straw Climax and pink tipped Santa Rosa. Light straw Wickson changed to yellow and blue Diamond became full blue during this period. Fruit picked in a more advanced color stage was usually of full color. Santa Rosa picked when full light red becomes dark and unattractive.

At 43° F very much less color development occurred. Usually fruit which was approximately half colored when picked would be full light color of characteristic shade when removed from storage. All varieties showed color development at this temperature, but much less marked than at 52° F. If the fruit in a car is loaded at a uniform color stage, upon arrival the top layers may be characteristic color for the variety, while the middle and lower layers will show far less color.

TABLE 3
RATE OF SOFTENING AND COLOR CHANGES OF PLUMS AT SHIPPING TEMPERATURES

| Location (1) | Color when picked (2) | At 43° F. | | | At 52° F. | | | | | |
|-----------------|-------------------------------------------|---------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------|------------------------------------------------|-----|----------------------------|------------------|
| | | Firm- ness when picked (pounds) | Firm- ness after 6 days 12 days (pounds) | Firm- ness after 6 days 12 days (pounds) | Firm- ness after 6 days 12 days (pounds) | Color after 12 days (pounds) | Market con- dition after 12 days (11) | | | |
| | | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| BEAUTY | | | | | | | | | | |
| Newcastle..... | Green to straw tip..... | 16.6 | 9.6 | 4.9 | Yellow to pink..... | Good..... | 6.5 | 3.5 | Light to dark red..... | Fair |
| Auburn..... | Light straw tip..... | 15.4 | 11.1 | ..... | Yellow to pink..... | Good..... | 3.0 | 2.8 | Light to medium red..... | Slightly ripe |
| Newcastle..... | Straw, slight pink tip..... | 11.1 | 8.4 | 4.2 | Yellow to pink..... | Good..... | 4.3 | 2.4 | Light to dark red..... | Fair |
| Auburn..... | Straw, slight pink tip..... | 10.9 | 5.9 | ..... | Yellow to pink..... | Fair..... | 2.5 | 2.5 | Light to medium red..... | Slightly ripe |
| Newcastle..... | Full straw to red tip..... | 7.0 | 4.1 | ..... | Yellow to pink..... | Slightly ripe..... | 1.7 | 1.5 | Medium to dark red..... | Too ripe |
| Newcastle..... | Full straw to red tip..... | 6.5 | 6.1 | 3.2 | $\frac{1}{2}$ to $\frac{3}{4}$ red..... | Fair..... | 3.4 | 2.2 | Light to dark red..... | Slightly ripe |
| Courtland..... | Full straw to red tip..... | 5.4 | 3.7 | ..... | Yellow to pink..... | Too ripe..... | 2.0 | 1.6 | Medium to dark red..... | Too ripe |
| Newcastle..... | $\frac{1}{2}$ to $\frac{3}{4}$ red..... | 5.1 | 3.3 | 1.7 | Yellowish-pink to red..... | Too ripe..... | 1.6 | 1.7 | Medium to dark red..... | Too ripe |
| Newcastle..... | $\frac{1}{2}$ to $\frac{3}{4}$ red..... | 4.8 | ..... | 1.4 | $\frac{1}{2}$ to full red..... | Too ripe..... | ..... | 1.1 | Dark red..... | Too ripe |
| Courtland..... | $\frac{1}{2}$ to $\frac{3}{4}$ red..... | 4.0 | 2.5 | 2.0 | Light red..... | Too ripe..... | 1.7 | 1.6 | Medium to dark red..... | Too ripe |
| FORMOSA | | | | | | | | | | |
| Newcastle..... | Green to light straw..... | 10.8 | 11.4 | 10.4 | Green to light straw..... | Firm but wilted..... | 8.6 | 4.2 | Yellow to slight pink..... | Firm but wilted. |
| Newcastle..... | Straw to pink tip..... | 11.0 | 10.1 | 9.3 | Full straw..... | Firm but wilted..... | 6.6 | 4.2 | Yellow to pink..... | Firm but wilted. |
| Newcastle..... | Straw to yellow..... | 8.0 | 7.5 | 4.5 | Full straw..... | Good..... | 3.7 | 2.0 | Yellowish-pink..... | Good |
| Newcastle..... | Yellow to $\frac{1}{3}$ pink..... | 4.6 | 3.9 | 2.7 | $\frac{1}{2}$ light red..... | Fair..... | 2.3 | 1.6 | Full light red..... | Slightly ripe |
| Newcastle..... | $\frac{1}{2}$ to $\frac{3}{4}$ color..... | 5.1 | 4.0 | 2.8 | $\frac{1}{2}$ to $\frac{3}{4}$ red..... | Fair..... | 2.7 | 1.1 | Full red..... | Too ripe |
| CLIMAX | | | | | | | | | | |
| Newcastle..... | Light to full straw..... | 16.6 | 16.2 | 6.6 | Full straw to pink tip..... | Good..... | 4.2 | 3.2 | Full red..... | Too ripe |
| Newcastle..... | Full straw to $\frac{1}{3}$ red..... | 9.0 | 8.4 | 3.2 | $\frac{1}{2}$ pink..... | Fair..... | 5.6 | 2.6 | Full red..... | Too ripe |
| Newcastle..... | Full light red..... | 8.6 | 6.2 | 4.2 | Full light red..... | Slightly ripe..... | 4.4 | 3.1 | Full red..... | Too ripe |

TABLE 3—(Continued)
RATE OF SOFTENING AND COLOR CHANGES OF PLUMS AT SHIPPING TEMPERATURES

| Location | Color when picked (2) | At 43° F. | | | | At 52° F. | | | | |
|----------------|-----------------------------------|----------------------------------------------------|-----------------------------------------------------|------------------------------------------------------|----------------------------|-----------------------------------------------|-----------------------------------------------------|------------------------------------------------------|-----------------------------|------------------------------------------------|
| | | Firm- ness when picked (pounds) (3) | Firm- ness after 6 days (pounds) (4) | Firm- ness after 12 days (pounds) (5) | Color after 12 days (6) | Market con- dition after 12 days (7) | Firm- ness after 6 days (pounds) (8) | Firm- ness after 12 days (pounds) (9) | Color after 12 days (10) | Market con- dition after 12 days (11) |
| | | | | | | | | | | |
| SANTA ROSA | | | | | | | | | | |
| Newcastle..... | Pink tip..... | 16.3 | 12.6 | 4.5 | Full light red..... | Good..... | 4.5 | 3.0 | Full red..... | Slightly ripe |
| Newcastle..... | ½ to ½ red..... | 15.8 | 12.3 | 4.7 | Full light red..... | Good..... | 3.9 | 2.8 | Full dark red..... | Too ripe |
| Newcastle..... | Full light red..... | 8.3 | 4.3 | 2.8 | Full light red..... | Fair..... | 3.0 | 2.4 | Full dark red..... | Too ripe |
| BURBANK | | | | | | | | | | |
| Newcastle..... | Green to straw tip..... | 17.6 | 14.1 | 4.8 | Straw to light yellow..... | Good..... | 3.3 | 2.2 | Full light red..... | Fair to slight- ly ripe. |
| Newcastle..... | Full straw..... | 16.3 | 8.5 | 3.9 | Light yellow..... | Good..... | 5.1 | 3.1 | Yellow, ¼ pink..... | Fair to slight- ly ripe |
| Newcastle..... | ¼ pink..... | 12.5 | 5.3 | 3.5 | Yellow to slight pink..... | Fair to slight- ly ripe. | 6.7 | 3.6 | Yellow, ½ pink..... | Too ripe |
| Newcastle..... | Yellow to ¼ pink..... | 11.1 | 6.2 | 3.7 | Yellow to ½ pink..... | Fair to slight- ly ripe. | 3.9 | 2.7 | Yellow, ½ pink..... | Too ripe |
| WICKSON | | | | | | | | | | |
| Newcastle..... | Light straw..... | 22.2 | 20.1 | 13.7 | Full straw..... | Good..... | 19.3 | 14.4 | Straw to yellow..... | Good |
| Newcastle..... | ½ straw..... | 16.3 | 13.0 | 7.4 | Greenish-yellow..... | Good..... | 12.4 | 4.8 | Yellow..... | Good to fair |
| Newcastle..... | Full straw..... | 13.9 | 9.5 | 6.5 | Greenish-yellow..... | Fair..... | 7.9 | 3.7 | Yellow..... | Fair |
| Newcastle..... | Greenish-yellow..... | 10.5 | 9.0 | 4.1 | Greenish-yellow..... | Fair..... | 6.1 | 3.0 | Yellow to slight pink..... | Fair |
| DUARTE | | | | | | | | | | |
| Newcastle..... | Green to slightly red tip..... | 18.6 | 11.3 | 5.0 | ½ light red..... | Good..... | 8.2 | 4.2 | Full light red..... | Good |
| Newcastle..... | Red tip to ⅓ light red..... | 18.1 | 9.0 | 4.6 | ¾ light red..... | Good..... | 7.0 | 4.3 | Full light red..... | Good |
| Newcastle..... | ⅔ to full light red..... | 16.1 | 10.0 | 5.0 | ¾ light red..... | Good..... | 6.4 | 2.9 | Full light red..... | Fair |
| Newcastle..... | ¾ to full light red..... | 12.2 | 10.2 | 5.4 | Full light red..... | Fair..... | 7.3 | 3.2 | Full red..... | Slightly ripe |
| Newcastle..... | ¾ to full dark red..... | 12.2 | 9.9 | 5.1 | ½ to full dark red..... | Fair..... | 6.9 | 3.4 | ½ to full dark red..... | Slightly ripe |

TABLE 3—(Concluded)
RATE OF SOFTENING AND COLOR CHANGES OF PLUMS AT SHIPPING TEMPERATURES

| Location | Color when picked (2) | At 43° F. | | | | At 52° F. | | | | | |
|----------------|--------------------------|---------------------------------------------|----------------------------------------------|-----------------------------------------------|---------------------------------------|-----------------------------------------------|----------------------------------------------|-----------------------------------------------|----------------------------------|------------------------------------------------|--------------------|
| | | Firm- ness when picked (pounds) | Firm- ness after 6 days (pounds) | Firm- ness after 12 days (pounds) | Color after 12 days (6) | Market con- dition after 12 days (7) | Firm- ness after 6 days (pounds) | Firm- ness after 12 days (pounds) | Color after 12 days (10) | Market con- dition after 12 days (11) | |
| | | (3) | (4) | (5) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| DIAMOND | | | | | | | | | | | |
| Newcastle..... | Blue tip to ¼ blue..... | 19.0 | 12.7 | 8.0 | ¾ to full blue..... | Good..... | 10.5 | 5.1 | Full blue..... | Fair | Fair |
| Newcastle..... | ½ blue..... | 19.0 | 10.3 | 6.0 | Full blue..... | Good..... | 7.6 | 4.1 | Full blue..... | Fair | Fair |
| Newcastle..... | ⅔ blue..... | 14.7 | 10.4 | 6.1 | Full light blue..... | Good..... | 6.1 | 3.9 | Full blue..... | Fair | Fair |
| Newcastle..... | Full blue..... | 10.4 | 9.1 | 5.6 | Full blue..... | Slightly ripe..... | 6.2 | 3.7 | Full blue..... | Fair | Slightly ripe |
| GIANT | | | | | | | | | | | |
| Newcastle..... | Straw to light red..... | 21.1 | 19.5 | 7.8 | Greenish-yellow, slightly red..... | Good..... | 10.4 | 4.8 | Greenish-yellow to ⅓ red..... | Good | Good |
| Newcastle..... | ¼ to ½ red..... | 19.6 | 17.1 | 6.3 | Greenish-yellow to ⅔ red..... | Good..... | 4.8 | 3.6 | ¾ to full red..... | Good | Good |
| Newcastle..... | ⅔ to ¾ full red..... | 16.5 | 11.5 | 3.8 | ¾ to full red..... | Good..... | 5.3 | 2.3 | ¾ to full red..... | Slightly ripe | Slightly ripe |
| Newcastle..... | Full red..... | 12.6 | 8.3 | 3.7 | Full red..... | Fair..... | 2.6 | 2.0 | Full red..... | Slightly ripe | Slightly ripe |
| PRESIDENT | | | | | | | | | | | |
| Newcastle..... | ⅓ blue..... | 13.7 | 12.7 | 7.1 | ¾ blue..... | Firm but wilted..... | 9.1 | 4.5 | ¾ blue..... | Firm but wilted | Firm but wilted |
| Newcastle..... | ½ blue..... | 12.2 | 10.6 | 6.7 | ⅓ to ¾ blue..... | Good..... | 7.8 | 3.6 | ¾ blue..... | Good | Good |
| Newcastle..... | ¾ blue..... | 10.5 | 11.2 | 5.2 | ¾ blue..... | Good..... | 8.6 | 3.7 | ¾ blue..... | Good | Good |
| Newcastle..... | Full blue..... | 10.0 | 9.6 | 6.6 | Full blue..... | Good..... | 8.0 | 4.5 | Full blue..... | Good | Good |

Samples of much of this fruit was also held at 35° F. The data on this fruit are not given, but relatively little increase in color occurred during a 12-day period.

Within the limits of picking maturity here studied, even the greenest lots when handled under temperatures approximating commercial shipping conditions, developed characteristic color for the variety. Lots of fruit only partially colored when removed from the lower car temperature (43° F) usually developed full color in two or three days at higher temperature.

Softening During Holding Tests.—Samples were tested both at the end of 6 and 12 days to determine the rate of softening under the different temperature conditions. Data are reported in columns 4, 5, 8 and 9, table 3.

Plums, in common with most other deciduous fruits, soften relatively rapidly between the time of picking and the time they are eating ripe, then soften slowly until overripe and wasty. With the tester here employed, tests of two pounds or under usually indicated full eating ripe condition. Fruit testing under two pounds at the end of 12 days would almost certainly be discounted on the market because of its condition. Most varieties of plums here studied softened about as much during 6 days at 52° F as they did in 12 days at 43° F. This held true in the faster softening varieties, including Beauty, Formosa, Climax, Santa Rosa and Giant. Duarte, Wickson, and President were slightly firmer after 12 days at 43° F than after 6 days at 52° F. For the more perishable varieties, it is apparent that softening proceeds approximately twice as rapidly in the top layers of fruit in cars loaded warm as in the lower portion of the same car.

Some of the earliest picked lots, particularly of Wickson, failed to soften and ripen properly, shrivelling instead. Even after removing to higher temperatures, this fruit remained firm and was practically valueless.

Market Condition at End of Twelve Days.—Market condition at the end of the 12 day period, columns 7 and 11, table 3 has been rated primarily on the color and firmness of the fruit. Fruit of full to dark color for the variety, or which was soft enough to be in prime eating condition, was rated as slightly ripe or too ripe for best market condition, since such fruit is undesirable for successful rehandling and retailing. Most all lots held at 43° F were in satisfactory market condition after 12 days, except some of the very ripe pickings of Beauty. At 52° F, however, the riper pickings of most of the varieties studied were too ripe for best market condition after 12 days.

EXPERIMENTAL TEST TRIP—SEASON, 1924

In order to secure first-hand information on the carrying quality of plums and other early fruit, the California Fruit Exchange in June, 1924, arranged a test trip of six cars of fruit, destined for the Chicago and New York markets. These cars originated at different shipping points, but were loaded simultaneously and assembled as a unit before leaving the state. Accompanying the cars from Roseville, California, to their destination were representatives of the Exchange, the Pacific Fruit Express Company, the California State Department of Agriculture and the University of California. In each instance one of this party carefully inspected the more important lots of fruit going into each car as it was loaded and reinspected these lots after their arrival at destination. All cars were loaded, handled and moved according to general commercial practice.

In addition to the regular commercial fruit lots, loaded without reference to their position in the car, other crates were included where the fruit had been carefully selected as to different degrees of maturity, varying from that considered slightly too immature to that somewhat riper than is generally shipped. These crates were placed in parts of the car known to represent the highest and lowest temperatures.

Each of the cars under test was equipped with electrical resistance thermometers, arranged as the car was loaded, so that air and fruit temperatures could be ascertained from different parts of the car at any time enroute without opening the door. These temperature readings were taken at four to six-hour intervals throughout the trip. The average temperatures of the top and bottom fruit layers are shown graphically in figure 3. The lowest temperatures and consequently those most favorable to retard ripening, were at the bottom of the load near the ice bunkers, while the highest temperatures were found to be in the top layers half-way between the door and the end of the car. Minimum air temperatures in the first position were from 40° to 36° F, while those in the second position were from 55° to 45° F. With the temperature of the fruit 75°–80° F when loaded and an outside temperature of 80°–90° F, each day, fruit in the cooler portions of the cars cooled to approximately 45° F within 12 hours after loading, while it required 6 to 7 days, or the running time to Omaha, for the fruit in the warmer portions of the cars to cool to 50° F. The temperature of the fruit throughout the top layers averaged 10° to 16° F above that in the bottom layers, this difference being greatest during the first three or four days in transit.

Table 4 shows the condition of Climax and Santa Rosa plums shipped in the car from Auburn, California, to Chicago, Illinois. While this car arrived at destination for sale on June 27, the seventh morning after leaving California, the fruit was not unloaded until the night of the 29th, making the holding period correspond more closely to New York than to Chicago delivery.

TABLE 4

RIPENING OF TEST CRATES OF CLIMAX AND SANTA ROSA PLUMS IN TRANSIT.
AUBURN, CALIFORNIA, TO CHICAGO, ILLINOIS. JUNE 19-30, 1924

| Variety | Condition when loaded | Position in car | Condition on arrival |
|-----------------|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Climax..... | Green; hard..... | Bottom, tier 1..... Bottom, tier 5..... Bottom, tier 10..... Top, tier 1..... Top, tier 5..... Top, tier 10..... | Green to straw with red tip; very firm. Straw to red tip to $\frac{1}{4}$ red; firm to springy. Straw to red tip to $\frac{1}{4}$ red; firm to springy. Red; firm to springy. |
| Climax..... | Straw to red tip; firm to springy. | Bottom, tier 1..... Bottom, tier 5..... Bottom, tier 10..... Top, tier 1..... Top, tier 5..... Top, tier 10..... | Straw to $\frac{1}{2}$ red; firm. Straw to $\frac{3}{8}$ red; firm to springy. Straw to $\frac{3}{8}$ red; firm to springy. Red; springy. |
| Climax..... | $\frac{1}{4}$ to $\frac{3}{4}$ red; springy..... | Bottom, tier 1..... Bottom, tier 5..... Bottom, tier 10..... Top, tier 1..... Top, tier 5..... Top, tier 10..... | $\frac{3}{4}$ to full red; firm to springy. Full red; firm to springy; slight decay. |
| Santa Rosa..... | $\frac{1}{4}$ to $\frac{3}{4}$ red color; very firm. | Bottom, tier 1..... Bottom, tier 5..... Bottom, tier 10..... Top, tier 1..... Top, tier 5..... Top, tier 10..... | $\frac{3}{4}$ red to full color; firm. Full to dark red; firm to springy. Full red; firm to springy. Full to dark red; firm to springy. Dark red; springy. No fruit. |
| Santa Rosa..... | $\frac{3}{4}$ to full red color; firm. | Bottom, tier 1..... Bottom, tier 5..... Bottom, tier 10..... Top, tier 1..... Top, tier 5..... Top, tier 10..... | Full to dark red; firm to springy. Full dark red; firm to springy. Dark red; firm to springy. Full dark red; firm to springy. Full dark red; firm to springy. Full dark red; springy to soft. |
| Santa Rosa..... | Full to dark red; firm ripe. | Bottom, tier 1..... Bottom, tier 5..... Bottom, tier 10..... Top, tier 1..... Top, tier 5..... Top, tier 10..... | Full to dark red; springy to slightly soft. Full to dark red; springy to slightly soft. Dark red; soft. Dark red; springy to soft. Dark red; springy to soft. No fruit. |

While all of this fruit arrived in fair condition, the riper pickings when loaded in the top of the car arrived too ripe to be well received by the trade. The first degree of maturity of Climax was rated "good market condition" while the second picking loaded in the top of the car was slightly riper than desirable and the third lot, picked when $\frac{1}{4}$ to $\frac{3}{4}$ red, was overripe. Twelve hours after unloading from the car, the second lot contained a number of soft plums, while the fruit of the third picking was all soft ripe. Santa Rosa was, on the whole, considerably riper than Climax. Fruit picked in the second stage of maturity, $\frac{3}{4}$ to full color, and carried in the top of the car arrived a dark red color and ready for immediate use. The mature picking showed half the specimens soft within 12 hours after unloading. As will be observed from the table, while the different maturity stages showed differences in color upon arrival, and also the fruit nearest the end of the cars was firmer than that carried nearer the center, yet the greatest difference was between the bottom and the top of the load, corresponding to the highest and lowest temperatures in the car.

In addition to these placed crates, inspections were also made on regular lots carried in different positions in the car. Inspections of these lots served to show the general average shipping quality of several additional varieties carried under the same conditions as the above test crates. The data are given in table 5.

TABLE 5

RIPENING OF COMMERCIAL LOTS OF PLUMS IN TRANSIT. AUBURN, CALIFORNIA, TO CHICAGO, ILLINOIS, JUNE 19-30, 1924

| Variety | Condition when loaded | Condition upon arrival |
|--------------|---------------------------------------------------------------------|------------------------------------------------|
| Beauty..... | Straw, red tip to $\frac{3}{4}$ light red; springy..... | 95% full red, 5% dark red; soft and ripe. |
| Beauty..... | Yellow to red, mostly $\frac{1}{2}$ to $\frac{3}{4}$ red; springy.. | All full red, ripe to soft ripe. |
| Shiro..... | Green to straw, very firm..... | Straw to yellow; springy. |
| Shiro..... | Straw to yellow, springy..... | Yellow; springy. |
| Formosa..... | Green to straw, very slight red..... | Yellowish-pink to red; springy; full ripe. |
| Formosa..... | Straw to pink red, slightly springy..... | Yellow-red to red; springy to soft, full ripe. |
| Tragedy..... | $\frac{1}{4}$ to $\frac{3}{4}$ color; firm to springy..... | Full purple; springy, 5% soft. |
| Tragedy..... | $\frac{3}{4}$ to full color, a few dark purple; firm to springy. | Full to dark purple, soft. |

As with the Climax and Santa Rosa test crates, these varieties, aside from the early picking of Shiro, were ready for immediate use upon arrival and would stand little rehandling.

LOT SHIPMENTS, 1926

During the season of 1926, in cooperation with the different shipping associations of Placer County, a careful study was made of the maturity and condition of arrival of commercial shipments. Approximately 100 lots of ten varieties were inspected at the time of loading in the cars and the packages numbered in such a manner that the position which any crate occupied in the car could be ascertained after the fruit was unloaded. With the shipping point inspection data recorded on one-half of a printed form, this copy was forwarded to the United States Department of Agriculture representative in New York who completed the record after making his observations. On the auction market, to which all the fruit was consigned, it was not possible to examine the same crates as previously inspected, yet representative crates of each grower's lot were opened and the general average condition of the shipment as a whole recorded. The results of the data secured, shown in table 6, give an excellent idea as to the maturity of the fruit shipped during the season and its carrying quality. It also furnished a further check upon the holding tests discussed above.

From table 6 the differences in carrying quality of the fruit loaded in different positions of the car is further emphasized. Averaging all varieties shipped throughout the season most of the shipments arrived in firm condition. However, with only the earliest varieties did any of the fruit, even in the bottom of cars, arrive "slightly green," whereas a rather too large percentage of other varieties, particularly Santa Rosa, Wickson and Giant, arrived "slightly ripe" to "ripe." Under variable temperatures it is impossible to have the load arrive 100 per cent "firm" without grading the fruit as to maturity when loading. As this seems impractical one can only endeavor to harvest the variety at a stage of maturity which will carry with the minimum percentage of loss, either from over or under maturity. During the season of 1926 it would seem that the earlier varieties were shipped in about their most satisfactory stage but that the later varieties were in some instances allowed to become slightly too ripe for best shipping.

RELATION OF MATURITY TO CARRYING QUALITY

From the above discussion, it is apparent that within limits, the earlier the fruit is picked the better the carrying quality will be. Fruit picked before it is beginning to show a color change will usually shrivel and fail to ripen properly, but once the color change has

TABLE 6

SHIPPING MATURITY AND CONDITION OF ARRIVAL. PLACER COUNTY PLUMS, 1926*

| Variety and description when shipped | Position in car | Condition on arrival, percentage | | | | Remarks |
|-----------------------------------------|-------------------|----------------------------------|---------------|------|----------------|-----------------------------------------------------------------------------------------|
| | | Ripe | Slightly ripe | Firm | Slightly green | |
| <i>Beauty:</i> | | | | | | |
| 60% straw tip. | Top third..... | 14 | 0 | 86 | 0 | Slight pink tip carried well. Fruit $\frac{1}{4}$ pink or more in top of car full ripe. |
| 32% pink tip. | Middle..... | 6 | 0 | 94 | 0 | |
| 8% $\frac{1}{2}$ color. | Bottom third..... | 2 | 0 | 98 | 0 | |
| <i>Climax:</i> | | | | | | |
| 62% green with straw tip. | Top third..... | 0 | 26 | 74 | 0 | Fruit carried well. Most crates arrived 'firm.' |
| | Middle..... | 0 | 6 | 94 | 0 | |
| 38% straw with pink tip. | Bottom third..... | 0 | 0 | 70 | 30 | |
| <i>Formosa:</i> | | | | | | |
| 10% green to straw tip. | Top third..... | 7 | 40 | 53 | 0 | Fruit shipped with pink tip arrived slightly overripe in top of car. |
| 80% full straw. | Middle..... | 0 | 12 | 84 | 4 | |
| 10% pink tip to $\frac{1}{2}$ pink. | Bottom third..... | 0 | 0 | 50 | 50 | |
| <i>Santa Rosa:</i> | | | | | | |
| 21% $\frac{1}{2}$ to $\frac{3}{4}$ red. | Top third..... | 0 | 62 | 38 | 0 | Most of fruit in top half of cars arrived too ripe for best returns. |
| 79% full red. | Middle..... | 10 | 35 | 55 | 0 | |
| | Bottom third..... | 0 | 0 | 100 | 0 | |
| <i>Wickson:</i> | | | | | | |
| 22% green to straw tip. | Top third..... | 29 | 47 | 24 | 0 | Top of car badly overripe. |
| 24% light straw. | Middle..... | 6 | 27 | 57 | 10 | |
| 28% full straw to yellow tip. | Bottom third..... | 0 | 17 | 49 | 34 | |
| 26% $\frac{1}{2}$ yellow. | | | | | | |
| <i>Duarte:</i> | | | | | | |
| 20% slight red color. | Top third..... | 25 | 5 | 70 | 0 | Fruit picked with full color arrived too ripe, bruising bad. |
| 45% $\frac{1}{2}$ color. | Middle..... | 10 | 2 | 88 | 0 | |
| 35% $\frac{2}{3}$ full color. | Bottom third..... | 0 | 5 | 95 | 0 | |
| <i>Diamond:</i> | | | | | | |
| 12% slight purple..... | Top third..... | 35 | 0 | 65 | 0 | Fruit of full color too ripe for top of car. 6% of fruit showing decay. |
| 30% $\frac{1}{2}$ purple. | Middle..... | 15 | 0 | 85 | 0 | |
| 58% $\frac{3}{4}$ to full purple. | Bottom third..... | 0 | 0 | 100 | 0 | |
| <i>Burbank:</i> | | | | | | |
| 70% straw tip to straw. | Top third..... | 35 | 0 | 65 | 0 | For best carrying quality fruit should not be past a good straw color. |
| 10% yellow. | Middle..... | 20 | 0 | 80 | 0 | |
| 15% pink tip. | Bottom third..... | 10 | 0 | 90 | 0 | |
| 5% $\frac{1}{2}$ to $\frac{3}{4}$ red. | | | | | | |
| <i>Giant:</i> | | | | | | |
| 25% slight pink. | Top third..... | 20 | 0 | 80 | 0 | Plums more than light red carried satisfactorily only in the lower half of the car. |
| 40% $\frac{3}{4}$ to full light red. | Middle..... | 15 | 0 | 85 | 0 | |
| 35% full red. | Bottom third..... | 0 | 0 | 100 | 0 | |
| <i>Grand Duke:</i> | | | | | | |
| 5% $\frac{1}{2}$ color. | Top third..... | 10 | 0 | 90 | 0 | Most of fruit arrived in very satisfactory condition. |
| 55% $\frac{3}{4}$ to full light color. | Middle..... | 4 | 6 | 90 | 0 | |
| 40% full color. | Bottom third..... | 0 | 4 | 96 | 0 | |

* The percentage figures refer to crates or other packages, rather than to the fruit in the packages. Thus a variety that was 50 per cent pink tip is one that showed the fruit predominately pink tipped in half the packages inspected. If 20 per cent of the top third is reported ripe, it means that 20 per cent of the packages in that position showed predominately a ripe condition.

definitely begun, the riper the plums when picked the shorter time they will hold up under the present temperature conditions prevailing in refrigerator cars.

TIME OF HARVESTING

From the foregoing discussion, it is evident that two main factors must be considered in determining at what stage to harvest any plum variety. Within limits, the greener the fruit when harvested the better will be its carrying quality. On the other hand, the riper the fruit when harvested the better will be its dessert quality when it reaches the hands of the consumer.

It is first of all essential that the fruit be delivered to the market and to the retailer in good, firm, attractive condition. The finest flavored fruit cannot be sold at a profit if it is overripe, decayed and wasty on the retail stands. On the other hand, a permanent industry requires that fruit of the highest possible dessert quality be secured. Consequently, the questions of plum maturity are (1) "How ripe can the different plum varieties become, prior to harvest, and still be delivered to market in good condition" and (2) "What is the earliest stage at which these varieties can be harvested, and still secure fair to good dessert quality." The answer to the first of these questions will vary largely with the temperatures in transit and the handling conditions to which the fruit is exposed.

TESTS FOR TIME OF PICKING

The firmness of the fruit when picked has proved to be most closely associated, of any of the factors studied, with the way the fruit will hold up under transit conditions. The firmness of the fruit, or the pressure test, is a more accurate index to carrying quality than color, since the earliest fruits to reach a certain color stage are almost invariably firmer and of better carrying quality than the later ripening plums from the same trees, and picked in the same color stage.

If the fact that late-coloring plums are usually softer is considered, color becomes a fairly safe guide to picking maturity for plums of the varieties here studied. The pressure test however should prove of value in connection with color, in establishing the condition of fruit in different orchards and in different seasons. Both color and pressure tests are given in table 7, where recommended picking conditions are summarized.

PICKING RECOMMENDATIONS

Fruit Shipped Standard Refrigeration.—Since the highest quality in the plum varieties here studied is secured by late picking, it follows that the maturity desirable when harvested will vary with the temperature conditions and time of the fruit in transit. As was shown earlier, the average temperature in the top layers of fruit in a standard refrigerator car loaded with hot fruit and 12 days in transit is near 53° F. Temperature averages in the test trip referred to earlier, and in several cars equipped with recording thermometers packed in the crates of fruit loaded in the top layer have shown the top layer temperatures to be about as follows, with fruit loaded at 75° to 80° F.

| | |
|-------------------|--------|
| First day | 70° |
| Second day | 60° |
| Third day | 56° |
| Fourth day | 54° |
| Fifth day | 52° |
| Sixth day | 50° |
| Seventh day | 46–48° |

If the fruit is shipped to markets closer than the Atlantic seaboard, average temperatures in the top of the load are even higher, since during the first few days the fruit is relatively warm. For example, during a six-day trip, the top temperatures will average 57° F. Thus even for relatively nearby markets, the fruit must be firm when picked.

The top layer temperatures represent the most unfavorable conditions in the car, but these conditions, rather than the average, must be considered in determining when to pick the fruit. Fruit picked in condition to carry satisfactorily in the top layers of the car will be in excellent condition upon arrival if loaded in lower portions of the car.

Recommendations in table 7, under the heading “when shipped standard refrigeration” are based on three seasons holding and shipping tests. The color and firmness range recommended include as the earliest color stage and firmest fruit, the earliest condition in which the fruit may be harvested and ripen with good appearance and fair flavor. The greatest amount of color and lowest pressure test figure represents about the most mature picking stage feasible if the fruit is loaded in the top of the car, and carried under the conditions outlined above. If fruit is riper than here recommended, it is likely to arrive on the eastern markets full dark color and soft in the top layers and be discounted in price.

TABLE 7

RECOMMENDED PICKING CONDITION FOR PLUMS. BASED UPON TEMPERATURES IN TRANSIT IN THE UPPER HALF OF REFRIGERATOR CARS

| Variety | When shipped standard refrigeration | | When precooled and shipped | |
|-----------------|-----------------------------------------------|------------------------------|--------------------------------------------|------------------------------|
| | Color range | Pressure test range (pounds) | Color range | Pressure test range (pounds) |
| (1) | (2) | (3) | (4) | (5) |
| Beauty..... | Straw tip to trace pink tip..... | 13- 9 | Pink tip to $\frac{1}{2}$ red..... | 8- 6 |
| Formosa..... | Straw tip to trace pink tip..... | 13- 9 | Pink tip to $\frac{1}{2}$ red..... | 8- 6 |
| Climax..... | Straw to pink tip..... | 18-13 | $\frac{1}{4}$ to $\frac{1}{2}$ red..... | 12- 8 |
| Santa Rosa..... | Trace red to $\frac{1}{2}$ light red..... | 18-12 | $\frac{1}{2}$ to full light red..... | 12- 9 |
| Burbank..... | Straw tip to full straw with slight red. | 20-14 | Yellow to $\frac{1}{4}$ red..... | 13- 8 |
| Wickson..... | Straw tip to yellow tip..... | 15-12 | $\frac{1}{2}$ to $\frac{3}{4}$ yellow..... | 11- 8 |
| Duarte..... | $\frac{1}{2}$ to $\frac{3}{4}$ light red..... | 15-11 | Full light to medium red..... | 10- 8 |
| Diamond..... | Trace to $\frac{3}{4}$ light blue..... | 20-15 | Full light to medium blue..... | 14-10 |
| Giant..... | $\frac{1}{4}$ to $\frac{3}{4}$ light red..... | 16-11 | Full light red..... | 10- 8 |
| President..... | $\frac{1}{2}$ to full light blue..... | 16-11 | Full blue..... | 10- 7 |

Fruit picked riper than the condition described in the first section of table 7 can be carried successfully if loaded in the bottom of the car. Where therefore, certain lots are known to be relatively ripe they will carry much better in the bottom half of the car, than if loaded in the upper layers.

Fruit Precooled.—Where it is possible to thoroughly cool fruit prior to loading or shipment, temperature conditions in transit will be quite different. If the fruit is cooled to 40° F prior to loading, it will from the start of the period in transit, be carried at the lowest temperature at which the ice in the car will hold it. The fruit in the top layer will warm up to from 46° to 48° F and carry at that temperature while in transit. The top layer temperatures in thoroughly precooled cars should not average above 45° to 46° F.

Under these temperature conditions, fruit somewhat more mature than recommended for non-precooled cars can be shipped. Columns 4 and 5 of table 7 give recommendations for the ripest fruit that can be handled with safety under such conditions.

When precooling is not available, somewhat faster cooling can be secured by adding 2 to 3 per cent of salt to the ice. Temperatures prevailing in such a car are shown in figure 4. A comparison of figures 3 and 4 shows that cooling was somewhat more rapid when the salt-ice was used. Temperatures in the top layer of the car shown in figure 4 averaged slightly over 2° F lower than in the car shown in figure 3.

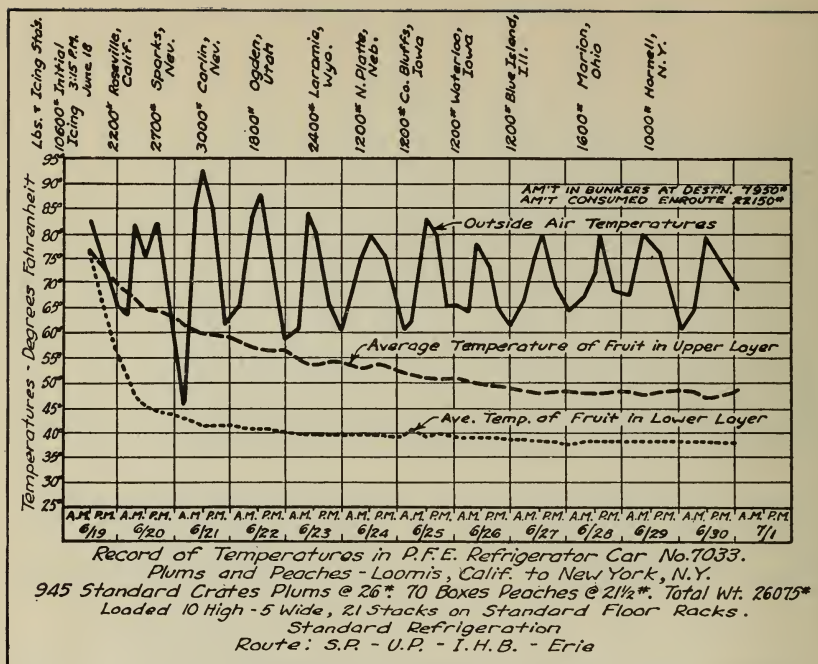


Fig. 3.—Average fruit temperatures under standard refrigeration. Roseville, California, to New York, N. Y.

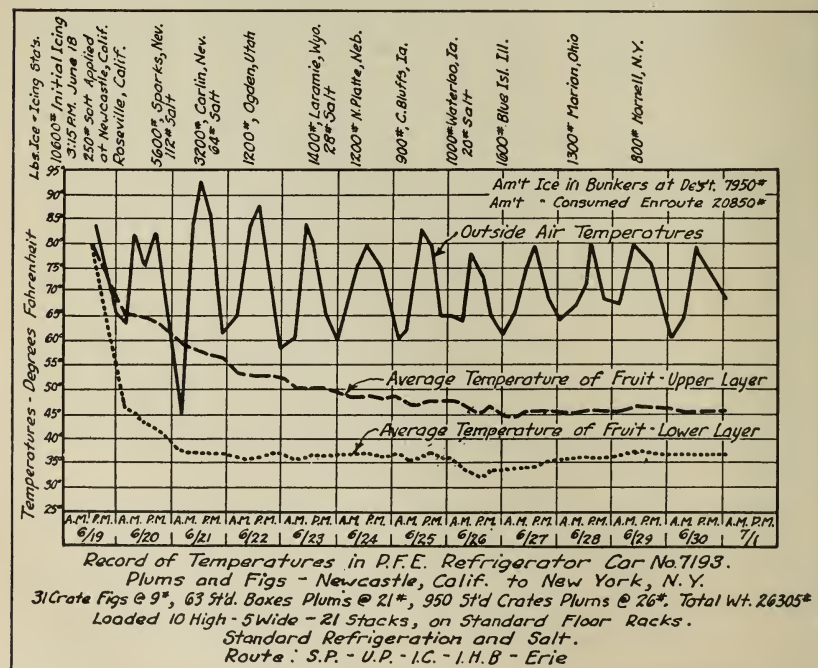


Fig. 4.—Average fruit temperatures in refrigerator car. Newcastle, California, to New York, N. Y. Standard refrigeration with addition of salt.

The necessity of getting the fruit under refrigeration as early as possible should also be emphasized. Such fruits as plums ripen almost twice as rapidly at 52° as at 43° F. At 70° F or above, the temperatures usually prevailing during the harvest season, ripening proceeds with great rapidity. The more quickly the fruit can be cooled following picking, the quicker ripening will be retarded, and the better the condition of the fruit upon arrival in eastern markets.

SUMMARY

CHANGES IN FRUIT BEFORE HARVESTING

Increase in Size.—Shipping plums continue to increase in size until they become full colored, the rate of increase becoming somewhat less as the fruit approaches full ripeness. At the time plums are usually harvested for eastern shipment, they are increasing in volume from 1.5 to 2 per cent daily. Picking earlier than is necessary for proper carrying quality results in smaller fruit and considerable loss in tonnage.

Increase in Color.—Changes in color are definitely associated with ripening. Coloring on the tree is influenced by the exposure to sunlight, those fruits on the upper or outer branches coloring earlier than those produced on the lower or inner branches. In some instances the latter fruits on a given date are as soft as those of higher color.

Softening of the Flesh.—Softening of the flesh occurs as plums mature on the tree. Measured by a mechanical tester, the firmness of the flesh gives an accurate index of the maturity and shipping quality of plums.

Increase in Soluble Solids.—Hydrometer readings on the juice of plums show a continuous increase in soluble solids from the first color changes to full maturity of the fruit. The amount of this increase during the possible harvest season is not sufficient for hydrometer readings to serve as an index to picking maturity.

Increase in Sugar Content.—Sugar content increases as long as the fruit remains on the tree. Actual sugar analyses show approximately half as much sugar present as the total soluble solids indicated by the Balling hydrometer.

Changes in Acid Content.—Plums contain from 1 to 3 per cent of acid when picked, this amount gradually decreasing with the latter pickings. In early picked fruit, the expressed juice and the fruit as a whole are approximately equal in acidity. In later pickings there is much less acid in the expressed juice.

CHANGES IN FRUIT AFTER HARVESTING

Color.—Unless picked exceedingly immature, plums are able to continue their color development after being harvested and in the absence of light. This change is influenced greatly by temperature, little color development occurring when the fruits are held below 36° F.

Softening.—After picking, plums rapidly lose their firmness. The rate of softening is largely controlled by temperature. At 52° F most varieties will soften approximately twice as rapidly as at 43° F. When full eating ripe they will test from one to two pounds.

Soluble Solids.—There is practically no increase in soluble solids after picking.

Sugar Content.—While a few of the larger, later-maturing and more meaty types of plums apparently make a slight gain in their total quantity of sugar after picking, most varieties show no increase after being removed from the tree.

Acidity.—The acid content of the expressed juice of plums decreases greatly after harvesting. The fruit as a whole shows only a slight decrease in acidity during this ripening period.

DETERMINATION OF SHIPPING MATURITY

Car Temperatures and Rates of Ripening in Transit.—Temperature records taken in transit show the temperature in cars of plums under standard refrigeration to average about 40° F on the floor of the car and about 53° F in the top fruit layers, during a 12-day period. With an outside air temperature of 80°–90° F each day and the fruit registering 75°–80° F when loaded, that placed in the coolest part of the car, was cooled to 45° F in 12 hours, while approximately 6 days was required to lower the temperature in the top layers to 50° F. Plums loaded in the top layers ripen far more while in transit than does fruit in the lower parts of the car.

Inspections of Commercial Lots.—Shipping point inspection of commercial shipments and reinspection at destination indicated that most plum varieties are being picked in as mature a condition as is feasible under present handling methods.

Dessert Quality.—The more mature plums are allowed to become before harvesting the higher the sugar content and the better their flavor. Fruit picked before showing some change in the green ground color of the skin may fail to ripen or soften properly.

Shipping Quality.—Within limits, the earlier picked fruits carry better under prevailing car temperatures than more mature fruit. Fruit must be picked sufficiently firm to carry to market in good condition.

Picking Indexes.—The firmness of the flesh and color of the fruit furnish the most satisfactory indexes of picking maturity. Detailed recommendations are given (table 7) for picking condition of different varieties, depending upon handling methods.

The Possibility of More Mature Picking.—Under present methods of handling in transit, most plum varieties are picked in as mature a condition as they can be satisfactorily delivered. Where precooling is feasible somewhat riper and consequently larger and better quality fruit may be shipped than is possible under standard refrigeration. The addition of 2 to 3 per cent of rock salt to the ice in the car bunkers accomplished slightly quicker cooling.

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The California Fruit Exchange invited the cooperation of the University of California and the United States Department of Agriculture in the car test trip and allowed the use of data secured from this test. The shipping organizations of Placer County cooperated heartily in allowing inspection records to be made on their commercial shipments, both at loading point and in New York.

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